THE GLASS INDUSTRY

VOLUME 22, NUMBER 5, MAY, 1941

ANNUAL MEETING OF THE CERAMIC SOCIETY

The forty-third annual meeting of the American Ceramic Society, held in Baltimore the week of April 5th, was characterized by full attendance and earnest work by all the Divisions and Sections. Registration reached a new high with student and feminine visitors boosting the registration figures substantially. The multi-hotel situation, with headquarters at the Lord Baltimore, proved no little detriment to the ceramists.

Sunday, the opening day of the convention, was a full day with the Board of Trustees' meeting in the morning. The Ceramic Education Council, M. E. Holmes presiding, met in the afternoon. In the evening, an informal dance was held in the Calvert Room.

President Carruthers and Secretary Purdy conducted the opening session on Monday morning in a dignified fashion. Following the formal reports of the officers, the induction of the newly elected officers of the Society and of twenty-eight new Fellows was performed as a rather impressive ceremony, in keeping with the size and importance of the Society.

The Orton lecture delivered by Dr. Ernst A. Hauser, M. I. T., was a splendid piece of work. X-ray studies and the important inferences drawn from them concerning the fine structure of matter have become somewhat familiar to ceramic technologists during the past few years. But it remained for Dr. Hauser to apply this ultra-modern style of chemistry to clays and related minerals and to show how the structure of these substances explains and defines their properties and uses. The speaker showed a fine power of exposition. His excellent models and slides lent reality to the subject matter. To many of his listeners, the address sounded the key-note of a new and more penetrating attack upon the problems of silicate technology.

The general sessions on Silicate Analysis and on Color were well attended and brought out a great deal of interesting discussion.

Plant trips, which had been on the wane the past few years, came to life again this year. Trips covering the Art, Enamel, Glass, Refractories, Structural and Materials and Equipment Divisions were carried out Thursday and Friday. For the glass man, visits were arranged to the Carr-Lowrey, Maryland Glass and Calvert Distilleries.

The ladies this year were well taken care of by Mrs. L. C. Roche who, as chairman of the Ladies Committee, efficiently organized the Ladies Tea on Sunday afternoon, and the three bus trips on Monday, Tuesday and Wednesday to historical points around Baltimore and Annapolis.

The Camera Club again proved that ceramists are interested in photography and can produce prize winning prints. The third salon was most successful, both in the number of prints hung and the quality of the prints. The prize winning pictures are shown on page 212 of this issue.

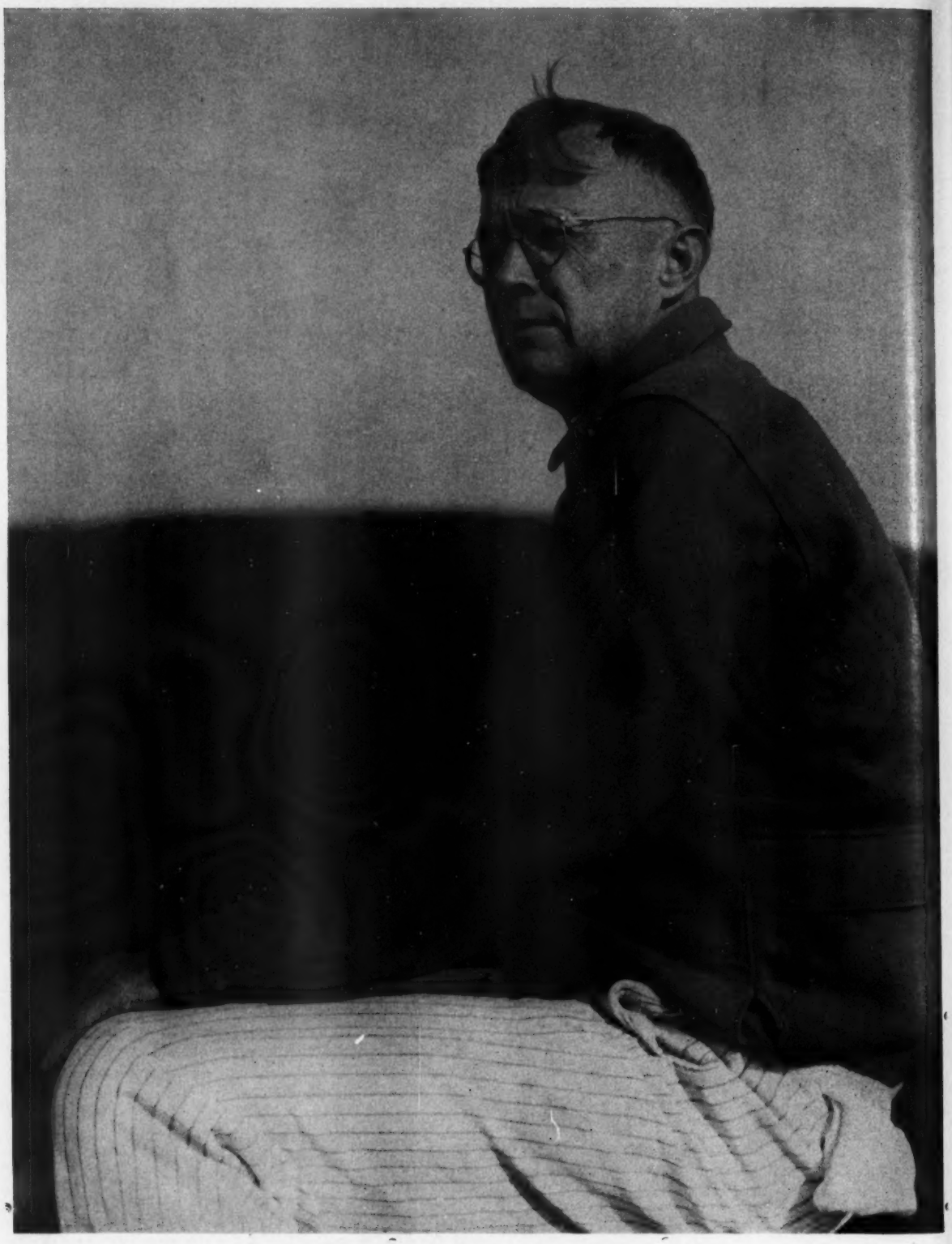
The first half day in the Glass Division was devoted largely to papers on durability. This work seems to have been carried to an extreme of precision which begins to discover that certain variables of storage and treatment and slight variations in the glass itself are affecting the experimental results more than the more controllable experimental variations. Reports on this program from consumers of bottles as well as from manufacturers' laboratories gave an interesting turn to the discussion.

In the afternoon, some fine work was reported on the analysis of gases dissolved in glass and gases present as seeds, which was by far the most revealing of any of the studies thus far presented on this rather intricate problem. The Preston Laboratories, whose high-speed thermostatically-controlled centrifuge for the separation of powdered glass into light and heavy fractions has enabled them to identify cord compositions, announced the development of a stroboscopic method by means of which their camera watched this process "on the fly."

The behavior of phosphates as opacifiers and of phosphate glasses without silica was treated very skillfully by Weyl and Kriedl of Penn State. The free use of ideas of structure gained from X-ray diffraction patterns, together with clever reasoning from the facts concerning formation of apatite as a mineral, enabled these men to bring out interesting and entirely plausible theories. Although the German habit of rather freely advancing theories in connection with all scientific studies is at variance with the habit of American technologists to pay strict attention to the accumulation of facts, and although it has often come in for some justifiable criticism, it is nevertheless refreshing and should be genuinely helpful in building a sound understanding of glassmaking processes.

The work of the Owens-Illinois laboratory in studying the effects of barium oxide and zinc oxide on the common bottle-glass compositions was very thoroughly done and presented in such a way as to catalog these matters definitely for future reference. R. A. Miller's presentation of the history and use of flat glass in various modes of production and application was a fine summary of this important branch of the industry.

Much of the time on Wednesday morning was given to reports of work on the structure of glass on the basis of X-ray diffraction studies. The anomalous behavior of boron oxide from this point of view received espe-



J. T. LITTLETON, THE NEW SKIPPER OF THE A.C.S.

This picture of the new president of the American Ceramic Society was taken at Lake Keuka a few years ago and shows Dr. Littleton at the helm of his boat "The Co-Ed". Dr. Littleton has been prominently identified with the glass industry for many years. He joined the Corning Glass Works in 1913 and was chief of its Physical Laboratory since 1920. Last year he was appointed Assistant Director of Research of that Company. He is one of the Glass Division's most distinguished members, and was chairman of the Division from 1929 to 1931. In 1932 he was chairman of the Publications Committee of the Society, and a Trustee from 1935 to 1938.

cially interesting treatment. The fact that the high expansibility of boron oxide glass can be reduced by the addition of sodium oxide up to a certain per cent equally well as by the addition of silica was neatly explained by Dr. Warren of M. I. T. on the basis of coordination numbers or, roughly, oxygen linkage. Under the patient instruction of this excellent teacher, the members of the Glass Division are becoming well acquainted with these modern ideas of the fine structure of their stuff and were probably better prepared to enjoy the Hauser lecture because of this training at previous sessions.

The Wednesday afternoon session dealt with some more practical matters. Mr. John A. Sharf of Washington, D. C., explained what happens to bottles when they are filled with charged beverages. The papers on glass batch mixing and on amber glass were reports of undergraduate thesis work and had a definite relationship to plant practice.

The paper on tantalum glass by Dr. K. H. Sun, University of Pittsburgh, was interesting from the standpoint of the advanced chemistry of unusual materials, although it dealt with an oxide which may not find industrial application. Dr. N. W. Taylor's paper on elastic aftereffects aroused warm theoretical discussion. The interference patterns formed when an optical flat is laid upon a piece of commercial flat glass present a rather definite way, according to the results of Adams and French of Mellon Institute, of distinguishing between plate and window glass. Now that drawn sheet glass is so well made, some such method is evidently necessary. The final paper, on fuel consumption in the glass tanks, offered involved mathematics and some unusually careful consideration of weather conditions as they affect furnace performance.

By this time the retiring chairman, W. R. Lester, whose three years of official duty for the Division ended, had turned the meeting over to the new chairman, A. K. Lyle, Hartford-Empire Company, who adjourned the session.

The business meeting of the Glass Division was held during the lunch hour, a custom introduced in recent years with such success that it bids fair to become permanent. About 75 members attended, with W. R. Lester presiding as chairman. Mr. Lester announced that a new committee, known as the Glass Advisory Board, had been appointed to cooperate with the Revision Committee for the U. S. Pharmacopeia. F. C. Flint reported for this committee that in cooperation with Dr. Krantz the Committee had dealt with the matter of light transmission through amber glasses used for the protection of certain drugs and chemicals. A specification providing for a maximum transmission of 15 per cent for wave lengths between 2900 and 4500 Angstrom units had been tentatively agreed upon. The problem of durability was next in order for discussion.

N. W. Taylor, Chairman of the Research Committee presented a report, providing for a plan of cooperative research. A motion was adopted that the Division go on record as favoring continued study of this plan, and the Committee was continued for another year.

The following officers were declared elected for the new fiscal year: chairman, A. K. Lyle, Hartford-Empire Company; vice chairman, W. C. Taylor, Corning Glass Works; second vice chairman, C. W. Parmelee, University of Illinois; secretary, S. R. Scholes, N. Y. State College of Ceramics.

Institute of Ceramic Engineers

The meeting was mostly routine consisting of reports of the various committees. The Committee on Membership and Examinations reported a total of 16 additions to the various grades of membership during the year, making a total of 284 as of that time. A large number of applications are on hand as a result of a recent letter sent to members of the American Ceramic Society and this will undoubtedly result in a considerable increase in the membership during the near future.

The Committee on Professional Status and Development prepared an analysis of ceramic engineering and its possibilities which should be of considerable value in clearly explaining the ceramic engineering profession to prospective students and should be helpful in attracting the right caliber of men to the ceramic engineering courses in the various schools.

The Committee on State Board of Engineering Examiners reported further progress in the recognition of ceramic engineers on a professional basis by the various states and this work is now practically complete.

The Committee on Ceramic Engineering Education reported a survey of the industry as to problems which were considered important and on which the ceramic schools might carry on some work. A total of 84 problems were suggested by the industries, among which the following are the more important relating to glass: (1) Radiation and absorption characteristics of molten glass at various temperatures. (2) Volatility of soda and other oxides from glass at various temperatures. (3) Rapid method for determination of cord varieties. (4) Temperature and flow effect on glass-Corhart interphase. The entire list of problems has been submitted to the schools and some of them have already indicated that work will be started on some of them during the coming year.

The treasury balance of the Institute has now reached an amount that will make it possible to undertake some worthwhile project. It was, therefore, decided to appoint a committee to study this situation and make recommendations at the next meeting as to how these funds could best be used.

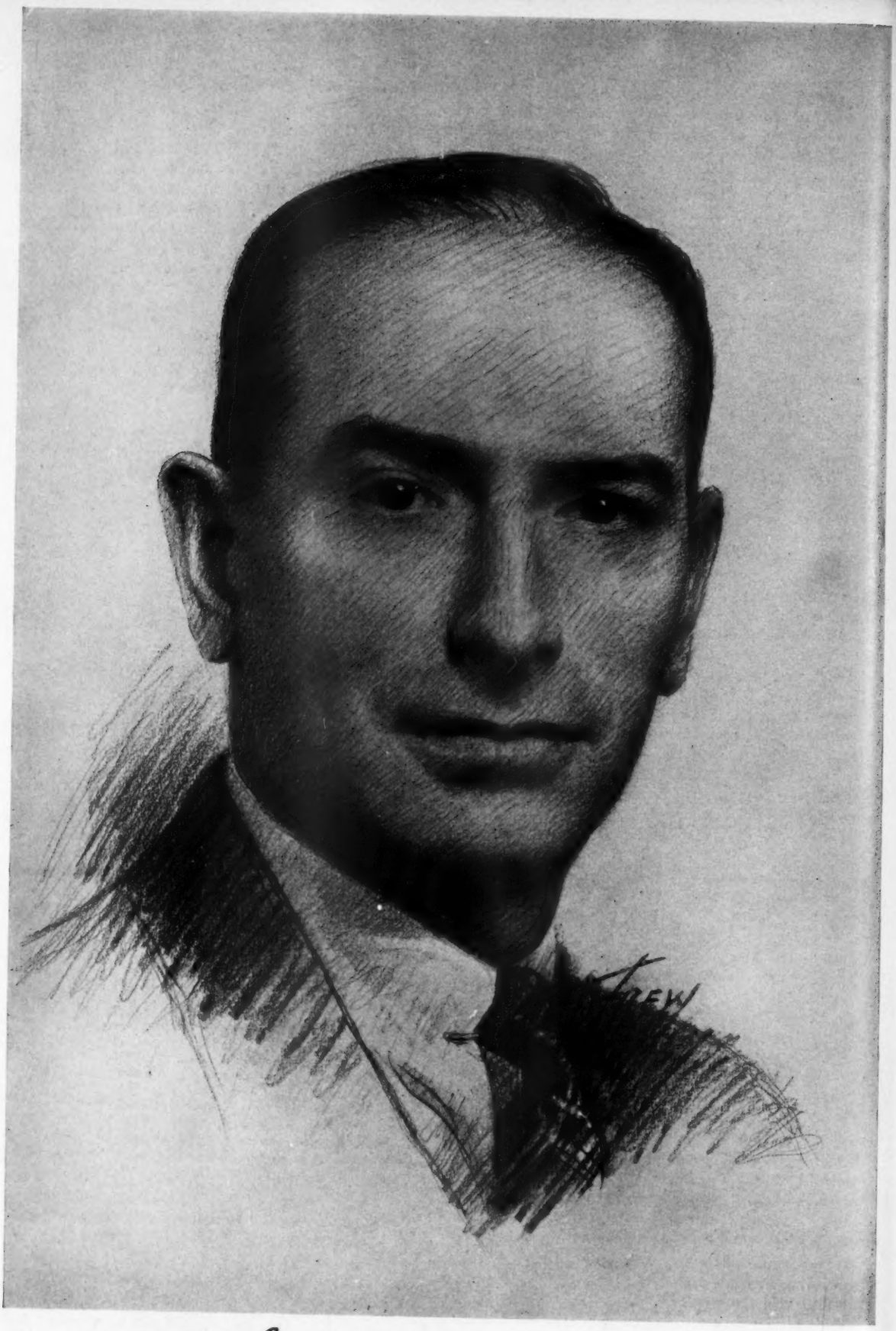
New Methods of Cleaning Glass Sands. *By J. Dasher and O. C. Ralston, Nonmetals Division, U. S. Bureau of Mines.*

A description of the various types of impurities present in sands and the various methods that may be employed to remove such impurities from sands which are to be used for glass-making was given. In the case of speck removal, such specks are usually iron-bearing and can be removed by high intensity magnetic separators. Froth flotation with soap-type reagents or classification and tabling may also be used. Stain removal may be accomplished by acid leaching or washing methods. If the stain is tough the attrition scrubber may be used.

A description of the attrition scrubber, its method of operation, the cost of operation and some of the results obtained by its use were described.

Effect of Storage Conditions on the Weathering and Chemical Durability of Commercial Glass Containers. *By J. S. Owens and E. C. Emanuel, Armstrong Cork Co.*

Eight-ounce capacity flint bottles of two different chemical compositions were stored empty, capped and uncapped. for periods up to 12 months at (1) 100° F., 80 per cent relative humidity; (2) 130° F., 10 per cent relative humidity; and (3) normal room temperature and humidity. At the end of the test period the degree of weathering was



A. K. Lyle

determined and alkali extraction tests using water at 50° C. and 120° C. were made.

From the data obtained it was concluded that the most important factor in the weathering conditions used is the humidity of the storage conditions. An improvement in durability was shown by the bottles that were stored at normal room conditions if the bottles were rinsed prior to the durability test. The initially less durable bottles were improved to a greater extent than the more durable ones. The results obtained with the two glass compositions showed that the important weathering effect of high humidity may be significantly controlled by means of the chemical composition of the glass.

A series of microphotographs of various types of weathered glass surfaces were shown and the crystalline material present was identified as aragonite.

Factors Influencing Autoclave Chemical Durability Test of Glass Containers. *By A. Herman, Joseph E. Segram & Sons, Inc.*

In this investigation various factors such as impurities in the distilled water, and variables such as time and temperature were studied in order to determine their effect on the reproducability and precision of an autoclave chemical durability test.

The test procedure used was in brief as follows: after the bottles were cleaned with a clean air blast they were filled with specially prepared distilled water and capped with tin foil. A pyrex flask filled with 400 ml of the distilled water was included as a blank. Both the samples and the blank were then heated in an autoclave for one hour at a temperature of 121° C. using a 30 min. heating up and a 30 min. cooling down schedule. After removal from the autoclave a 100 ml aliquot from each bottle was titrated while still hot with N/50H_2SO_4 using methyl red indicator. All results are corrected for the blank titration and expressed as milligrams sodium hydroxide per liter. The distilled water was prepared by redistilling laboratory distilled water in a pyrex glass still and boiling to ¾ of its original volume immediately before use. Precautions were taken to prevent its contamination with CO_2 while it was cooling to room temperature.

In the experimental procedure this basic procedure was modified by using water containing various and known amounts of impurities and by the use of different test temperatures and different lengths of test times. Conductivity measurements were also made on the various extractory media and the resulting extracts.

The data obtained on the nine different 8 oz. flat bottles used for test were given in the form of tables which may be summarized as follows: when the specially prepared distilled water was used, the agreement in the results obtained in five different tests was excellent, however, when small amounts of copper, namely 0.1, 0.2, 0.5, 1.0, 1.5, 2.0 and 3.0 parts per million, in the form of copper sulphate was added to this distilled water a marked decrease in the amount of alkaline material leached from the bottle was noted. The amount of alkali decreasing as the copper content increased. Small amounts, namely, 4 and 8 parts per million, of lead and iron in the distilled water showed that iron had more effect on the alkalinity decrease than had lead, but that neither iron nor lead had as much influence as copper. In addition, lead seemed to be more selective in its action, influencing only those bottles that gave up the most alkali. The addition of 4 and 8 parts per million of either sodium carbonate or sodium silicate to the special water slightly increased the amount of alkali leached from the glass.

From the results of the various conductivity tests it was concluded that such measurements are a satisfactory indicator of the quality of the distilled water but that they are unreliable for measuring the chemical durability of the glass.

In the investigation of the effect of time and temperature, the test times used were 1, 2, 3, 4, and 5 hours at temperatures of 60, 75, 90, 105, and 121° C. From the data obtained it was concluded that of the two factors, i. e., the length of time used for the leaching, and the temperature at which the leaching is carried out, that the latter has the greater effect on the amount of alkali removed from the glass.

Investigation of Variable Factors in Accelerated Autoclave Chemical Durability Tests. *By J. S. Owens and E. C. Emanuel, Armstrong Cork Co.*

The importance of the 1 hr. at 121° C. autoclave durability test and the difficulty of obtaining reproducible results by it, warranted an investigation of certain of the test variables in an effort to improve its precision and accuarcy. The variables chosen for this investigation were (1) the effect of the distilled water, (2) the effect of rinsing, (3) the effect of the internal area of the bottle, (4) the effect of the volume of water in the bottle, (5) the effect of time and temperature.

From the results obtained it was concluded that the purity of the distilled water is a very important factor. Minute traces of certain elements, notably copper and iron, and small amounts of CO_2 are detrimental. It was recommended that doubly-distilled water, prepared in an all-pyrex still to the boiler of which is added a small amount of H_3PO_4, be used. As various rinsing procedures may cause a deviation from the normal test as great as —1.04 mg. NaOH per liter a standardized rinsing method must be also used. The internal area of the container must be taken into account in the evaluation of the chemical durability of any particular type of bottle. The effect of increasing the volume of water placed in the bottle, was found to decrease the concentration of alkali in the liquid extract, but the total amount of alkali extracted and the amount of alkali extracted per unit of total internal area was found to increase. Both the durations of the different periods of the heat cycle and of the temperature must be carefully controlled. The temperature deviation being the more important of the two. It was further concluded that by standardization of the technique the normal error in the results of the tests on the eight ounce bottles used may be reduced to no more than ±3 per cent of the alkali extracted.

Method of Testing Surface Alkalinity of Glass Bottles. *By A. J. Liebmann and M. Rosenblatt; Schenley Distillers Corp.*

In order to test the suitability of various types of glass containers for the packaging of gin, whiskey and other alcoholic liquors the authors have developed a method of testing the surface alkalinity of glass bottles and in addition have developed a statistical method for analyzing the results obtained.

The method in brief consists of first thoroughly rinsing the bottles twice with hot tap water, twice with distilled water and once with the extracting medium draining between each washing. The containers are then filled, in the case of 16 oz. capacity bottles, with 425 ml of the leaching medium leaving 50 ml headspace. The leaching medium may be CO_2 free singly distilled water, 45 per cent by volume neutral alcohol or 45 per cent by volume gin. The bottles are capped by inserting a tapered cork covered with aluminum foil in the neck of the bottle and sealing with a screw cap. The filled and loosely capped bottles are then placed in a special design constant temperature water bath, resealed after the bath reached 70° C., heated to 90° C. in from 50 to 75 minutes and kept at this temperature for 24 hours. The bath is then rapidly cooled to 71° C. by the means of cooling coils, the bottles removed and the corks removed after which they are replaced in the bath and cooled to 25° C. The bottles and their contents are well shaken and in the case of water 250 ml of extract is taken for titration. With the alcoholic solutions 250 ml of sample is placed in a flask, 25 ml of 0.01 N H_2SO_4 added and the alcohol distilled off. The flask is heated to boiling, four drops of 0.04 per cent brom thymol blue added and the solution titrated with 0.01 N NaOH to a blue end point. The alkali extracted is expressed in milligrams of NaOH per liter.

Analysis of Gases Dissolved in Glass and Gases Present in Seed. *By H. A. Shadduck and A. Van Zee, Owens-Illinois Glass Co.*

One of the difficulties in determining gases in glass by the high temperature-vacuum method is the condensation in

UNCONVENTIONAL PICTURE

1-2. Registration. From a quiet start, business picked up to such an extent that all previous attendance records were broken.

3. Models used by Dr. E. A. Hauser, which with a fine power of exposition, put reality into the subject matter of this year's Orton lecture and suggested a new and more penetrating attack upon the problems of silicate technology.

4. The Glass Division luncheon. Individual tables are an aid to informality and promote good fellowship.

5. The retiring president of the A.C.S., Jack Carruthers.

6. Bailey and Sharp, two names that always will be inseparably associated among glassmen.

7. S. R. Scholes is amused at something said by a speaker at one of the technical sessions.

8. Frank Root and E. E. Marbaker of O. Hommel demonstrate that glass technologists require more than a strictly scientific diet.

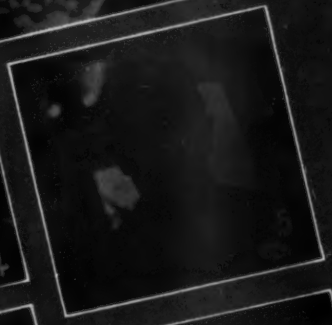
9. Dr. Herbert Insley, U. S. Bureau of Standards.

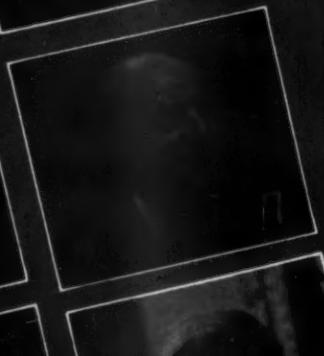
10. Miss Marie Eckardt of A.C.S. headquarters goes to work on a prospect for membership.

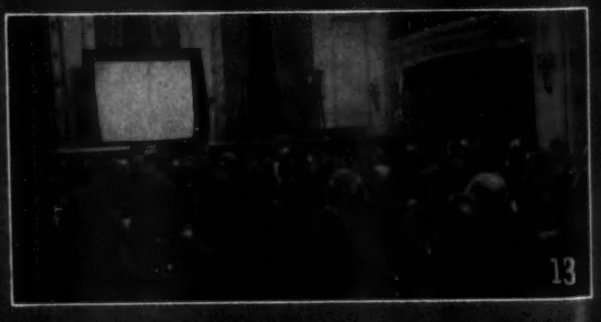
11. Charming Mrs. Roche, chairman of Ladies Entertainment, disclosing some of her plans, which made this year's A.C.S. meeting one of exceptional pleasure to the women folk.

12. V. V. Kelsey and G. H. Brown, from the New Jersey delegation.

13. Glass Division meeting.



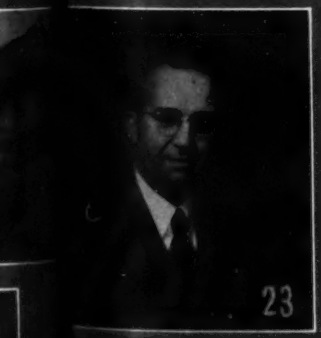


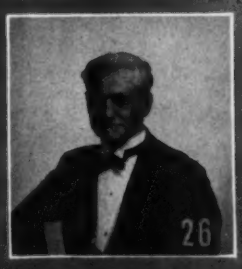


THE A.C.S. CONVENTION

14. Another Glass Division meeting.
15. The General Luncheon on Monday.
16. Adjournment of the Glass Division luncheon.
17. Professor Parmalee discussing his plans for the Urbana Conference on glass problems with W. R. Lester, C. B. Delgado, L. C. Roche and John Ogden.
18. Vic Remington and J. Glass Venable inspecting the Handbook together.
19. J. C. Keaney and his Pittsburgh smile.
20. President-elect J. T. Littleton and James Bailey.
21. Francis Flint acts as escort for Dr. J. C. Krantz, Jr., of the U.S.P. Revision Committee.
22. F. C. Flint buttonholes Dr. George Morey.
23. The new president of the Ceramic Camera Club, G. Milton Ehlers.
24. Model Louise Boteler poses at the Camera Club dinner.
25. Model Helen Hayes poses in a Dutch girl costume.
26. Ross Purdy turns model, and gives further evidence of his astounding versatility.
27. Earl Frazier, E. L. Hettinger and Milt Ehlers packing up the Camera Club exhibit.

The candid camera shots on these facing pages, as well as on pages 207 and 209 were taken by Ceramic Camera Club fans E. L. Hettinger, Willson Products Co; Ernest Hommel of *Ceramic Forum*; W. R. Schlehr, Carr-Lowrey Glass Co; and J. R. Hostetter, Glass Industry. To these excellent photographers, we acknowledge our thanks and appreciation.





the apparatus of the sublimed alkaline constituents from the glass. In the apparatus used by the authors this difficulty has been largely overcome by the addition of an auxiliary furnace to the main furnace assembly. Its purpose being to dissociate the compounds formed by the alkaline sublimate and so liberate the gases. The apparatus, its method of use and type of results obtained were illustrated. In the case of two commercial glasses the total volume of gas obtained was in the order of 1 cc. per gram of glass. The gas was found to be a mixture of water, sulphur dioxide, carbon dioxide and oxygen. In the case of a special glass containing both boron and fluorine the gas from the glass was found to contain both silicon tetrafluoride and boron trifluoride. Samples of glass from both the doghouse and the forehearth were found to be similar in gas content. In one glass a blistery condition which developed was found to be due to an increase in SO_2 content of the gases.

A technique has also been developed for the analysis of the gases present in seeds. In brief the method consists of cutting the seed and surrounding glass from the bottle and drawing it out into a capillary in the flame. The capillary is there broken under mercury and the temperature of the closed end successively lowered. As the boiling point of any particular gas in the mixture is reached, condensation takes place, the volume of the mixture decreases, corresponding to the amount of gas condensed, and the mercury slug changes position. The apparatus used with this method was illustrated and curves obtained with both known and unknown gases shown. With certain mixtures of gases the technique has been modified so that it is possible to introduce certain chemical reagents into the capillary and thus determining the nature and amount of the gas by actual absorption. Results obtained by this procedure on commercial seeds were given. Seeds have been found to contain oxygen and nitrogen, or sulfur dioxide, or carbon dioxide in special cases. Seeds in amber glass have been found to contain a deposit on the inside, which has proved to be a sulphate or sulfite. Such seeds contain either nitrogen or practically no gas at all.

Cord Analysis. *By J. C. Turnbull, Preston Laboratories.*

The technique employed in the centrifuge method of separating cordy glass has been improved with the result that cleaner and larger cuts of the sample may now be made. In addition, the centrifuge has been equipped with windows and illuminated with stroboscopic light thus making it possible to observe directly the separation as it occurs in the rotating centrifuge. This improvement in the centrifuge apparatus enables the density distribution of the suspended powder to be measured. From the data obtained curves are drawn and from the shape of the curve some ideas regarding the type of cord may be obtained.

Density distribution curves obtained from glass mixtures and cords having known histories were shown and illustrated the various types of curves that may be obtained by this procedure. In general if the curve has a tail on one end, the cord consists of some foreign material such as silica or alumina from the block. But the shape of the curve and the analysis of the powder give an indication of the amount of foreign material and show what the material is. Random batch errors or batch segregation give an S shaped curve. Incomplete melting cords give the same type of curve.

It was concluded that while this procedure will not give an absolutely complete diagnosis of cords the information that is obtained when combined with the information that the operator has on a tank such as the extent of batch weighing errors, segregation, refractory wear, etc., will result in a better understanding of the nature and causes of a cordy condition.

Phosphates in Opal Glasses. *By W. A. Weyl, Department of Ceramics, Pennsylvania State College.*

The use of phosphates in the manufacture of opal glasses has been known for centuries, but their manufacture has been difficult and uncertain as there was no complete understanding of the nature of the opacifying cogents. In this present study new ideas of why and how bone ash acts as an opacifier have been developed.

From mineralogical considerations and by a study of photomicrographs of opal glasses containing phosphates it is suggested that the formation of apatile crystals are responsible for phosphate opacification. The composition of the apatite crystals may be expressed by the general formula,

$$3M_3\,R_2O_8 \cdot MX_2$$

In which
M = Ca, Pb, Mn, and others
R = P, As, or V
X = F, Cl, or OH

By substituting lead oxide for calcium oxide, a change is made from the apatite group of minerals to the isomorphous group of pyromorphites, which have a considerably lower melting point. A partial replacement of calcium oxide by lead oxide should also have beneficial effects on the properties of bone ash opals.

Phosphate Glasses and Some Characteristic Properties. *By N. J. Kreidl and W. A. Weyl, Department of Ceramics, Pennsylvania State College.*

Nearly all commercial glasses made today contain silica as an essential constituent. In the present work a new series of pure phosphate glasses has been studied in which no silica was used. Glasses containing up to over 90 per cent aluminum and no monovalent fluxes, or in many cases, no bivalent fluxes were obtained within the range of normal melting temperatures. These glasses possess unusual properties such as high chemical resistance, high ultra-violet transmission, and good electrical insulating characteristics and in spite of their higher price they appear to be of potential interest to the electrical industry. The striking similarity between the structures of crystalline aluminum phosphate and quartz seems to account for these exceptional properties.

Phosphorous Compounds as Reducing and Firing Agents for Glasses. *By W. A. Weyl and N. J. Kreidl, Department of Ceramics, Pennsylvania State College.*

In the manufacture of certain heat-absorbing glasses such as goggles, wire glass for roofs of buildings, and automobile windshields, etc., the absorption of the infra-red region is obtained by the use of iron-compounds in the glass. The iron, however, must be in the reduced condition for satisfactory absorption and the usual firing agents which in nearly all cases depend upon the evolution of oxygen at high temperatures for their efficiency cannot be used in the manufacture of such heat-absorbing glasses. It was found that the addition of phosphorous and phosphides to such batches are very useful for getting the glass free of bubbles and maintaining the proper color. Both actions were found to take place simultaneously. Phosphorous compounds were also found to have the same effect in copper-ruby glasses in which the copper is in a reduced state.

The Effect of Barium Oxide and Zinc Oxide on Certain Physical and Chemical Properties of a Soda-Dolomite Lime-silica Glass. *A contribution of the General Research Laboratory, Owens-Illinois Glass Co.*

During the past several years an extensive investigation has been carried out on the effect of composition on the various physical and chemical properties of soda-lime glasses. In the present report the results of a study on the effect of substituting (1) BaO and (2) ZnO for (a) SiO_2, (b) $CaO \cdot MgO$, and (c) Na_2O in a typical soda-dolomite lime—silica glass were given.

The raw materials used were Ottawa Sand, burned dolomite, Solvay soda ash, barium carbonate, zinc oxide and ammonium sulphate, the latter being used in small amounts as a firing agent. The batches were contained in large covered platinum crucibles and were melted in a gas-fired furnace, each glass being stirred several times during the initial melting period. After melting they were poured, crushed and remelted with further stirring. The melting temperature being 2600°F. (*Continued on page* 208)

NIGHT ON THE CHESAPEAKE

The scenes on this page were shot on the *S.S. Chesapeake* (but remember the date, April 1). This was the "Big Party" of the convention.

28. Mob scene. Guests were regaled with a nautical floor show as they consumed tons of the famous sea delicacies for which Baltimore is famous.

29. A blonde (Carmen Guercio), a red-head (Mrs. John Hostetter), and a brunette (Mrs. Chester Grigsby), with their escorts, R. N. Fisher and Chester Grigsby. (The third escort held the camera.)

30. E. L. Hettinger, chatting with a table full of ceramo-mariners, pauses to salute the camera.

31. Looking down upon the saloon. The two Mrs. Hostetters, Mrs. William Clark, Mrs. John Rolfe, Mrs. Karl Peiler, and Mrs. Buchannon.

32. Believe it or not, roller skating acts belong in a nautical floor show. Ask anyone who was there.

33. C. A. Walworth is assisted in blowing out the candles on the birthday cake. It is known that at least three others at the convention have birthdays on April 1.

34. The three Hostetters.

35. The Francis Flints, with their son and two daughters.

36. Mrs. Lester and Fred Dixon resuscitating a hungry mariner.

37. Dr. Besserik prefers blondes.

38. The three Pinkertons — not a vaudeville act, but the men who stood the watch.

39. Chauncey Frazier and Mr. Dixon dispute the problem of mold metals.

40. Louis Navias and the F. H. Wheaton, Jrs.

The properties which were measured and the methods of measurement of the resulting glasses were briefly as follows: 1. Density, the glass sample was crushed to pass a 100-mesh sieve, remelted, fired and annealed at 1100°F. A 4 to 6 gram sample was then weighed both in air and CO_2 free distilled water at a temperature of 72 to 75°F. The density determinations were considered to have an accuracy of the order of ±.0003. 2. Liquidus Temperatures, theses were measured by the temperature gradient method as described by Silverman. 3. Coefficient of Expansion and Deformation Temperature, both of these properties were measured by the interferometer method. In the case of the deformation temperature this was taken as the temperature at which the glass ceased to expand in the interferometer method when the dilation characteristics of the glass was being determined. 4. Viscosity. (a) Fiber Softening Point, this temperature was determined by the fiber softening point method described by Littleton, (b) High Temperature Viscosity, these were measured by the falling sphere method described by Hunter at four different temperatures for each glass, ranging from about 2450° F down to the liquidus temperature 5. Resistance to Dilute Acid, the acid durabilities were determined by the powder method using the procedure outlined in the American Ceramic Society Method No. 1. 6. Resistance to Distilled Water, this method consisted of a modification of the acid powder method in which distilled water was substituted for the acid.

From the data obtained it was shown that: 1. Both oxides, regardless of what they replace, increase the density of the base glass and that both oxides are similar in their effect. 2. When BaO replaces silica the liquidus temperature is lowered while Zno first lowers and then raises the liquidus temperature. When CaO·MgO is replaced ZnO causes a much less rapid rise in liquidus temperature than does BaO. 3. Substitution of SiO_2 by BaO or ZnO appreciably increases the expansion. When CaO·MgO is replaced only a slight increase results while when Na_2O is replaced there is a considerable decrease in the expansion factor. In the case of SiO_2 replacement BaO increases the expansion considerably more than does ZnO. 4. Substitution of BaO for either SiO_2 or CaO·MgO results in a appreciable lowering of the deformation temperature. ZnO causes less change. 5. BaO when substituted for CaO·MgO decreases the setting rate to a greater extent than does ZnO substituted in the same manner. 6. In the case of durability, neither oxide increase the acid resistance when substituted for SiO_2 or CaO·MgO. When SiO_2 or CaO·MgO is replaced by BaO the water resistance is decreased while in the case of ZnO it is increased.

Summary of Work on Atomic Arrangement in Glass. *By B. E. Warren, Dept. of Physics, Massachusetts Institute of Technology.*

Our present picture of the atomic arrangement in glass has been developed from four kinds of information, namely (1) laws of crystal chemistry, (2) X-ray diffraction study of glass, (3) the measurement of various physical properties of glass, and (4) kinds of materials and the ranges of composition in which glass forming properties exist. By X-ray studies the predominating type of bonding in the glass has been established. Secondary features such as those which change with annealing or conditioning do not show up in the X-ray pattern.

By using purely geometrical consideration, involving atomic sizes and the number of neighbors it is possible to make calculations which satisfactorily explains various phenomena such as immiscibility in glasses and the borate glass anomalies. In the case of immiscibility it has been found that in a lime-silica melt, for lime content less that about 28 per cent, the liquid segregates into two immiscible phases. By calculation a value of 33 per cent is obtained which in view of the approximations involved, may be considered to be in satisfactory agreement with the experimental value. In the case of the sodium-borate glasses a similar method of calculation indicates that at a value of 12.4 per cent Na_2O there should be a change in physical properties with composition. This calculated figure also agrees very well with the experimental data.

X-Ray Diffraction Studies of Some Soda-Lime Silica Glasses. *By J. Biscoe, Dept. of Physics, Massachusetts Institute of Technology.*

Using the procedure as described by Warren the X-ray diffraction patterns of three soda-lime-silica glasses have been studied by the Fourier integral method. With all three glasses the radial distribution curves obtained were similar. The first, and only peak which is resolved occurs at about 1.62 A.U. and corresponds to the silicon-oxygen distance. From the area of this peak it is indicated that each silicon atom is surrounded by four oxygens. The remaining peaks on the radial distribution curves are not resolved however but a peak would be expected at about 2.65 A.U. and would correspond to the distance between oxygens of the same silicon-oxygen tetrahedron. Due to the sodium-oxygen distance another peak would also be expected at about 2.7 A.U. and its area would correspond to about 6 oxygens around a sodium atom. By drawing these two peaks on the radial distribution curves, there remains a peak at about 2.4 A.U. whose area roughly corresponds to 7 oxygens about a calcium.

The interpretation of these curves allows the following picture of the structure of the glasses to be drawn, each silicon is surrounded by 4 oxygens. Some of the oxygens are bonded to 2 silicons and the remainder to but one. This forms a continuous random network with rather large holes in which the calcium and sodium ions are located.

X-Ray Diffraction and Physical Properties of Potassium Borate Glasses. *By R. L. Green, Research Laboratory, General Electric Company.*

Previous investigators have shown that X-ray studies of simple borate glasses are capable of giving results applicable to an explanation of their physical properties and a review of previous work shows that the borate glasses are quite consistent in their abnormal behaviour. A series of potassium borate glasses having a range of composition from 0 to 40 per cent by weight of K_2O were prepared and subjected to an X-ray study. Various physical properties, including thermal expansion, density, refractive index and viscosity were also measured on the glasses. The curves of composition versus transformation point, thermal expansion, softening point, density and refractive index all showed a change in slope in the composition range of 20 to 30 per cent of K_2O. The data obtained in the X-ray studies indicated that with an increase in K_2O content there was a change from three-fold to four-fold coordination.

It was concluded that the random-network picture of structure as well as the tendency for boron atoms to assume tetrahedral coordination in alkaline borate glasses satisfactorily explains both the X-ray diffraction curves and the anomalous physical behaviour of the potassium borate glasses.

Conditions Encountered During the Filling of Pressure Ware. *By John M. Sharf, American Bottlers of Carbonated Beverages.*

Of the two types of service demand that pressure ware encounters, the first, that found in the trade, has already been reported by other workers to vary with locality, leaving for consideration that encountered in the bottling plant. This may be further classified into plant conditions more subject to the operator's control (i.e., mechanical effects of conveying and handling or the thermal, chemical, and mechanical phases of bottle washing) and those more subject to inherent machine design such as the filling and closure (crowning) cycles, when the ware may be subjected to internal pressure, thermal, and mechanical effects. It is this latter which is considered here.

Many beverages filled into pressure ware contain dissolved carbon dioxide in amounts varying with the particular product. The gas content is generally spoken of as volumes (Bunsen's *alpha*) per volume of liquid; low carbonation is about 2 volumes, general average, about 3.5, and high, 4.5 volumes. These amounts of carbon dioxide are in the supersaturation range when considered at atmospheric pressure, and therefore must have a pressure above atmospheric main-

PLANT TRIPS — BEFORE, DURING AND AFTER

41. Reunion in Baltimore. Fred Dixon, "Chats" Walsh, G. F. Metz, Percy Cole, J. L. Crawford, M. C. Babcock, and C. W. Batchel.
42. Mrs. W. M. Weathers.
43. Much the same as 41 above, except that R. W. Knauft has joined the party.
44. Presentation ceremony. Chairman W. R. Lester receives an award of merit from Mr. A. Herman.
45. R. Sherwood, Armand Houze and G. F. Metz.
46. H. M. Brenner of Drakenfeld.
47 A cup of coffee, by Chauncey Frazier.
48. Bob Louden, host of McGean Chemical, opens a new bottle of Old Grandad.
49. W. R. Lester about to take a party through Maryland Glass.
50. A. E. Williams, Armand Houze, Joe Wright and Louis Navias waiting in front of Calverts.
51. W. R. Lester and another group of "plant trippers."
52. Maryland Glass.
53. Messrs. Williams, Wright, and Houze.

tained during handling and filling for their retention. In accordance with the general gas absorption laws, the pressure needed increases with rising temperature. Minimum theoretical values for carbonations of 2.0 volumes in water will go from 4 pounds per square inch gage at 35° F. to 38 p.s.i. at 100° F.; at the same temperatures, a 3.5 volume carbonation will give 18 to 78 p.s.i., while a 4.5 volume carbonation will give 27 to 104 p.s.i. The temperature therefore definitely influences the amount of handling pressure needed; actual operation pressures may be higher than the minimum, due to mechanical agitation, turbulence, foreign gases, etc.

Substantially all filling and closing (crowning) machines in use today can be classified into two general groups depending on their cycle of action. The first group may be called *coincidental* fill-crown, since the bottle receives its portion of carbonated water (or beverage) and is crowned in the same location in the machine, all within a few seconds. During the cycle, the bottle is sealed by a rubber cushion on the reinforcing ring, a counter-pressure is built up in the bottle, and the carbonated water delivered against this counter-pressure by means of a metered pump through a delivery tube; the tube then rises, the crown slides over the locking ring and is crimped by a descending crowning sleeve, while the counter-pressure is continuously maintained.

The second group may be called *successive* fill-crown, since the bottle progresses in a step-wise or successive manner through the counter pressure, filling release of pressure, and finally crowning, usually taking more than twenty seconds for the series of operations. In the cycle, the counter-pressure on the bottle is released before the crown-closure is applied to the finish; definite stability of the water is acquired by using cool water with the resultingly lower gas pressure. One type of machine in this classification has a valve system which allows low pressure water delivery, but requires very stable carbonation brought about customarily by water temperatures at about 40° F.; such may be designated as low pressure-temperature (low P-temp) under this major classification. The other type, with a different valve system, may operate at slightly higher water temperature (usually 45°-55° F.), and correspondingly higher pressures; such may be designated as intermediate pressure-temperature (inter P-temp) under the major classification.

In each case, the thermal effect will be the chill of the inside surfaces of the wear from the temperatures of the bottle leaving the washer (usually in the range of 60° to 80° F.) by contact with the colder water (or beverage) being filled, and will be influenced by the rate of water delivery. The mechanical loading occurs as the crown is applied, and may be a vertical load approaching 750 pounds, although most machines operate at an intermediate value. The internal pressure on the war varies with the type of machine and is readily demonstrated by typical examples of each, filling split size bottles (6-8 fl. oz.) with products having a carbonation of about 3.5 volumes. The *coincidental* fill-crown unit operated with 60° F. water showed a filling pressure of 65 p.s.i. (gage) and delivered the water into the bottle in approximately 1½ seconds; the crown was applied while the pressure was still maintained with an extremely rapid crowning thrust. With the *successive* types the water delivery time was approximately 15 seconds in each case, and the pressure was released before the crown was applied; the differences were in the temperature and pressure, for the inter P-temp unit used a 50° F. water at a pressure of 55 p.s.i., while the low P-temp used a 38° F. water and a pressure of 28 p.s.i.

By these conditions, whatever effects occur during the steps are determined. Products of higher or lower carbonation will show corresponding differences in pressure.

Glass Batch Mixing. *By W. E. Brownell and S. R. Scholes, New York State College of Ceramics.*

By the use of a small specially-designed laboratory batch mixer the effect of various factors such as mixing time, grain size, and mixing speed on the degree of mixing of glass batches were investigated. The degree of mixing was determined by the chemical analysis of various parts of the mix and comparing the results so obtained.

From the results it was concluded that the idea of segregation by continued mixing is fallacious but that both the mixing time and speed of mixing is important if well mixed batches are to be obtained. The use of water did not greatly improve the perfection of mixing in fact if the water was not added to the sand before the other constituents were added very poor results were obtained. The use of very fine grained materials was shown to improve the rate and thoroughness of mixing.

Characteristic Interference Patterns of Plate and Window Glass. *By F. W. Adams and P. W. French, Mellon Institute.*

A simple laboratory procedure has been developed for quickly distinguishing window glass from plate glass by means of interference patterns with monochromatic illumination. A small sample of the glass is placed in a holder below an optical flat which may be adjusted by means of leveling screws to a substantially parallel alignment with the glass specimen. Illumination with a sodium vapor lamp and diffusing screen provide a satisfactory source of monochromatic light. Visual observation of the interference bands permits the patterns of various types of flat glass to be distinguished. Sufficient light intensity for taking photographs with a small camera is available.

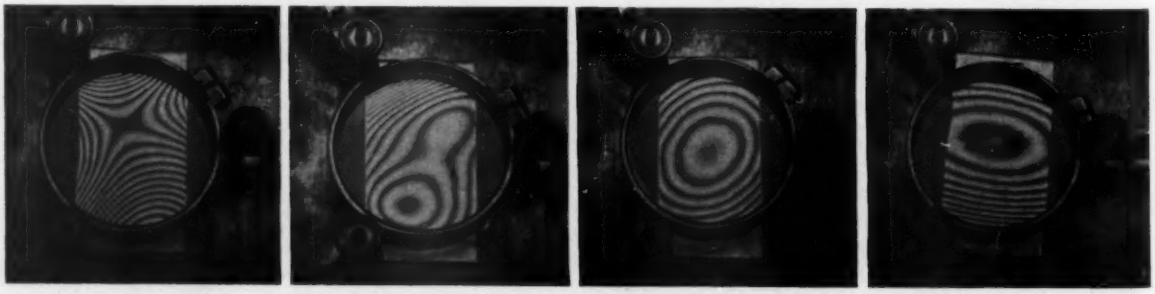
The results of this study show that: 1) The number of bands shown by plate glass is always small; by window glass usually large. 2) The bands of plate glass are generally circular or elliptical, occasionally hyperbolic; the bands of window glass trace asymmetrical topographies. 3) The bands of window glass are generally clear and sharp; the bands of plate glass show a fuzziness resulting from grinding marks.

Characteristic patterns of samples of plate glass and window glass of various methods of manufacture were presented to illustrate the efficacy of this method. The application of this technique to two specimens of unknown origin and to a second optical flat proved of interest.

Amber Glass and the Role of Carbon. *By H. Moore and S. R. Scholes. New York State College of Ceramics.*

Using a base glass of the following composition SiO_2-75 per cent; Na_2O-17 per cent, and CaO-8 per cent the influence

CHARACTERISTIC INTERFERENCE PATTERNS OF PLATE AND WINDOW GLASS



Window glass | Window glass reversed | Plate glass | Plate glass reversed

Top row, left to right. A. K. Lyle, W. R. Lester, A. E. Badger, E. L. Hettinger.

Below, left to right. G. E. F. Lundell, G. R. Shelton, G. W. Morey.

GLASSMEN NEWLY ELECTED TO A.C.S. FELLOWSHIP

of various factors on the development of an amber color were investigated. It was concluded that the development of an amber coloration is due to sulphur, the carbon acting only as a reducing agent. The presence of iron increases the color intensity probably by the formation of an iron-sulphur compound. In glasses containing less than 15 per cent alkali the development of a satisfactory amber coloration was difficult. As the percentage of alkali increased the color becomes progressively darker. When potash is used as the alkali the color tends toward a red-amber. More intense colors are obtained when sulphates were used in place of the element and the colors produced by the use of sulphates were more readily reproduced.

Tantalum Glass: K_2O-Ta_2O_5-SiO_2 Series. *By K. H. Sun and A. Silverman, University of Pittsburgh.*

In this investigation a series of glasses in the system, K_2O-Ta_2O_5-SiO_2 having a range of composition (limited by the fixed melting temperature of 1400°C) extending from 21 to 38 per cent of potassium oxide, 5 to 36 per cent of tantala and 39 to 71 per cent of silica were prepared and some of their physical properties studied. The raw materials used consisted of tantalum pentoxide, which contained 96.58 per cent Ta_2O_5, 0.68 per cent Cb_2O_5, 2.01 per cent SiO_2, 0.05 per cent TiO_2 and 0.62 per cent ignition loss; silica containing 99.72 per cent SiO_2; and potassium carbonate of 99.90 per cent purity. An induction type electric furnace was used for melting the batches and all melts were made at a temperature of 1400°C and the glasses after melting was complete were stirred 4 or 5 times at 15 min. intervals.

The density of the glasses were measured by weighing the samples in air and in toluene and the values obtained corrected for the air buoyancy. The refractive indices of the polished glasses for the sodium D line were measured on a Abbe refractometer, using α bromonaphalene as a contact medium.

The data obtained were studied and the partial molal volume and refractivities, based on the Gladstone-Dale and Lorentz-Lorenz formulas were evaluated.

It was concluded that tantala, as compared with silica and phosphorous pentoxide, is a poor "network former." The high oxygen to tantalum ratio and the relatively large Ta-O distance result in the formation of new singly bonded oxygens and a glass that is loose in structure. Practically, tantala occupies a position between barium oxide and lead oxide in its contribution of properties to glass, and it may be substituted for barium oxide to improve optical properties. Its relatively low melting point is also desirable.

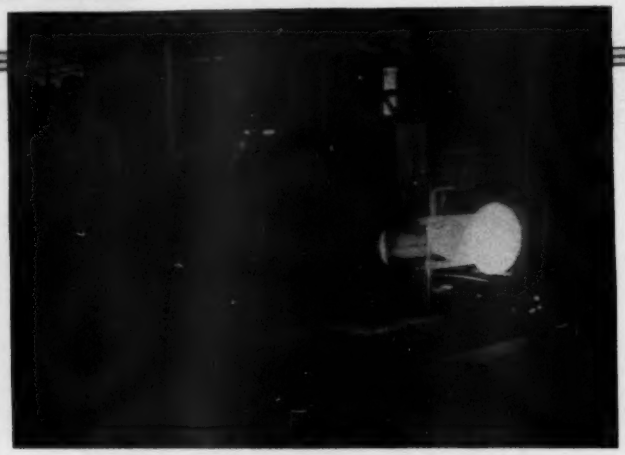
Elastic After-effects and Dielectric Absorption in Glass. *By N. W. Taylor, Department of Ceramics, Pennsylvania State College.*

Glass, rubber and similar substances have an unusual property of possesing a memory of their past history. For example, if twisted first to the left and then to the right the samples will relax by twisting to the right and then to the left. This effect was illustrated by the use of a small model containing a glass fibre which had been previously twisted and held in the twisted position for several hours. At the beginning of the paper the fibre was released and during the talk slowly moved through a 180° arc. Slides were presented in which it was shown that glass insulators and condenscis also showed similar electrical effects.

In simple language the explanation for these memory effects is that many kinds of molecules are present in a glass and some kinds remember one stimulus and some another. It was also shown that Von Schweidleis theory of dielectric absorption and Taylor and Doran's theory of the delayed elastic effect in glasses are anathematically of the same form and are both in accordance with the "random net-work" picture of glass as based on X-ray studies. The understanding of these elastic after-effects and the dielectric absorption behaviours of glass are very important in connection with the design of electrical insulators and the annealing of glass for thermometers.

PRIZE WINNING PICTURES
at the CAMERA CLUB SALON

FRAZIER AWARD WINNER



HAND BLOWING WINDOW GLASS
Industrial: Honorable Mention and Frazier Award Winner. By E. L. Hettinger.

GRAVEYARD
Scientific: First Prize. By L. M. Austin.

THE GLASS SKIMMER
Industrial: First Prize. By Rex New

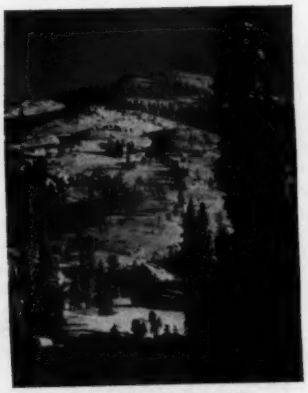
THREE POINT LANDING
Action: First Prize. By G. Milton Ehlers.

MAINSHEET
Pictorial: First Prize. By Daridge H. Rowland.

DUET
Portrait: First Prize. By Dari H. Rowland.

HUNGARIAN GIRL
Portrait: Honorable Mention. By Roy W. Wampler.

RECEIVER HAD NO CHANCE
Action: Honorable Mention. By J. Earl Frazier.



DONNER PEAK
Pictorial: Honorable Mention. By George A. Mays.

GLASS SIGNAL BELLS

By H. JUNGNITZ*

In recent years, efforts have been expended to use glass as the engineering material for an ever-increasing field of application. Glass is made of materials exclusively domestic (German), and its use will thus economize metals. In the search for new uses, the question has been raised whether it would ever be practical to replace metal bells on sounding boards by glass bells. The interest shown by the proprietors of one factory was sufficiently encouraging to warrant taking up the problem seriously.

The first thing to be demonstrated was to what extent common commercial glass would serve for this purpose. Therefore, a few bells like that shown in section in Fig. 1 were made out of ordinary soda-lime pressed glass. These bells were about the same size as the metal bells. The walls, in consideration of the different properties of the material, were made thicker and the external shape was correct for satisfactory ringing form. The upper opening, which served to attach the bell to its fastening, was pressed thin and afterward bored out with Widia tools. These pressed glass bells were set in a sounding board built for the purpose, and their utility was more closely investigated. It immediately appeared, however, that glass bells formed out of this soda-lime glass were by no means the equal of the regular bells. Not only was the volume of sound insufficient, but the tone was not satisfactory. The sound was more comparable to a clatter. Moreover, in comparison with the metal bells, the slow dying-away of the ringing was completely lacking.

With respect to the other properties which are essential to glass bells, these initial experiments furnished important conclusions. It appeared that the mechanical strength was entirely adequate, as several time trials under strenuous conditions demonstrated. It was also found that these bells could be screwed tightly into position with safety.

The opinion is generally held that lead crystal glass, in comparison with other glasses, possesses a particularly pleasant tone. The necessary experiments directed to the improvement of the unsatisfactory tone were therefore aimed in this direction. They produced the desired result. The new glass met the requirements with its good

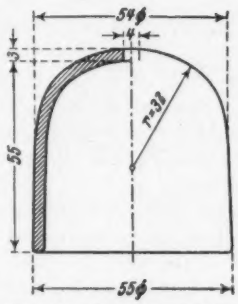


Fig. 1. Glass signal bell, (2") section.

ringing tone, principally because of its high lead oxide content. The tone was full and sufficiently loud and strong. Also, these glass bells showed much the same slow after-tone that is possessed by metal bells.

After the problem of a satisfactory glass composition had thus been solved, the following subject was taken up: certain counding boards, in which two metal bells are mounted, offer measured differences in pitch between the bells. In order to be able to fit these with glass bells, there must be found some way to change the pitch of the bells in definite fashion. Among all the factors concerned with pitch, only the following three came directly into the question: the composition of the glass, the outer form and shape, and the wall thickness.

The first possibility of changing the pitch of the bells in a definite way was therefore presented by the use of different compositions. However, repeated attempts showed that this offered slight possibilities. Variable melting conditions caused different volatilizations and therefore changed the glass compostions, especially in connection with those oxides most responsible for the tone. Also, operating conditions made it appear advisable to avoid using different compositions.

The second means, that of changing the external form of the bells, could not conveniently be used. The metal bells for which the glass bells are to be substituted are especially fitted in design for mounting on the sounding boards. Any change in the bells without corresponding change in the sounding boards was therefore not possible. Since this change was unconditionally forbidden, the size and shape of the bells had to be left as they were.

The third means for changing the pitch indicated a simple method of practical accomplishment. If both the external dimensions and shape of the bells remained fixed, the wall thicknesses could be altered within certain

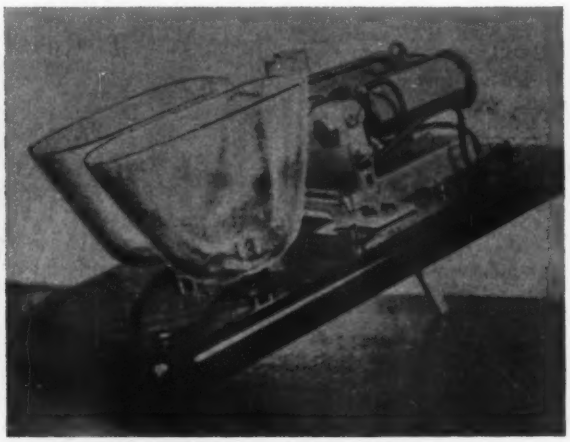


Fig. 2. Above. Three forms of glass bells.
Fig. 3. Right. Sounding board with the bells.

limits. For the later production of the bells, this was of great importance, since bells differing from each other in tone could be made from the same pot of glass. A simple change in the plunger, easily made during the progress of the work, was all that was necessary.

The following slight improvement in the glass bells was undertaken with the idea of improving lasting qualities and getting regular production. Thus, when the required wall thickness had been established with certainty, two vents were made in the mold at the level of the rim of the bell through which the excess glass could flow away. The resulting fins were then cracked off, and the bells were ground flat and polished.

In order to prevent the bells from splitting or cracking when they were fastened in position, thick raised bosses were formed on each side of the hole in which grooves were made. Thus, secure vertical fastening was made possible.

Figure 2 shows glass bells in three different types. The bell in the center served in the previously mentioned experiments. The bell at the left, in cowbell shape, and the one at the right, in a half-round form, also find practical uses. Figure 3 shows an exposed sounding board in which two cowbells are installed, and which is in service in the Post Office Department.

Although a solution for the substitution of glass bells for metal bells has been found, this was not yet completely satisfactory because a large quantity of lead oxide was necessary for these ringing glasses. The War, which brings an increasing demand for certain raw materials, lays down the necessity that the bell glass must eventually be made from completely domestic materials available in unlimited quantity. Even this requirement has been satisfactorily reached. Eventually, a glass was developed for the purpose, which not only has the necessary excellent tonal properties, but is made exclusively from domestic raw materials.

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*Translated by S. R. Scholes from *Glastechn. Ber.*, April, 1940.

Translator's note:—While this item is of no direct technical importance to us, it is of interest in showing to what lengths the Germans are going in their efforts to conserve metals and other materials essential in the war industries. Curiously, the author does not mention potash, which, notwithstanding the reputation for sonority possessed by lead glasses, is really the element responsible for the excellent tone of the so-called lead-crystal glasses.

ANNOUNCES "THINNEST" PLATE GLASS

"The world's thinnest plate glass" manufactured by a new process developed after months of research by the Franklin Glass Corporation,, Butler, Pennsylvania, has been announced by A. L. Pasquier, vice president and general manager. The new glass is three sixty-fourths of an inch, one-half the former minimum thickness ever produced commercially. When laminated, as is being done in large quantities by the Renfrew Division of the company, a safecy glass results that is thinner and lighter in weight than ever before made.

During the past month, Mr. Pasquier states, 1,500,000 laminated sunglass lenses were produced. These were made in the old Clearview Glass Company plant, acquired by Franklin last December. The product is expected to be used extensively for defense purposes, such as in goggles and air craft. If used in trans-Atlantic clippers, for example, it would reduce the flying weight 165 pounds.

The remodeled Renfrew plant is operating a continuous line of 15 grinders and 20 polishing machines. Over 700 employees in Butler and Renfrew are working on orders already received for the new product and various sizes of plate glass.

WHO CAN ANSWER THIS —

Editor, THE GLASS INDUSTRY:

When I was a small boy, it was impressed on me by some persons now unknown that I should always be careful not to use for boiler gage-glasses, tubes that were scratched inside. Not that I ever did, but apparently it was considered a necessary part of a boy's education to know this. So far as I can recall, the information was empirical, and no reason given for it; I remember, however, that it was stated that scratches on the outside were unimportant.

There are at least three good reasons why the inside scratching is dangerous: (1) some gage glasses, at least, are not well annealed, and the inside is in tension; (2) steam and hot water under some circumstances temporarily weaken scratches, though in the long run they are apt to "fortify" them; (3) the gage glass is apt to get rapped on the *outside* and under these circumstances *internal* scratches are apt to start a crack.

Can anyone tell me what reason, if any, was assigned 20 or 30 years ago?

F. W. PRESTON

CAMERA CLUB MEETS

The Ceramic Camera Club held its annual dinner meeting on Wednesday of the Ceramic Society meeting. After a silent invocation in memory of the late J. M. McKinley, founder of the Club, President E. L. Hettinger introduced the guest of honor, J. L. Carruthers, president of the American Ceramic Society.

Professor Carruthers presented the Chauncey E. Frazier Award of Merit to Mr. Hettinger for his picture "Hand Blowing Window Glass." In a brief address he told of his early association at Ohio State College with the son of the designer of the plaque, Frederick Carder. Judges for the award were Francis C. Flint, Charles D. Spencer, and Prof. J. Palin Thorley.

A new feature was introduced into the program this year in having present some models for the members to photograph. The professional models were Helen Hayes and Louise Boteler, and these were assisted by Dr. Ross Purdy and Miss Marie Eckardt of the American Ceramic Society staff.

A special prize of a large ground and polished glass tray was presented to J. Earl Frazier for having submitted the most outstanding print quality portrait "El Chico." Prize winners of the Third Annual Salon together with their entries are shown elsewhere in this issue of THE GLASS INDUSTRY. Judges of these awards were John S. Rowan, Mr. Barkley and Mr. Emery.

Elections to the new Board of Governors included G. Milton Ehlers, chairman; Robert W. Knauft, secretary-treasurer; V. H. Remington, W. R. Schlehr and Charles D. Spencer.

TOLEDO TRIAL ENDS SECOND MONTH

Following the testimony of F. Goodwin Smith, president of Hartford-Empire Co., who was on the stand for 20 days as the first Government witness in the anti-trust suit which the Department of Justice is prosecuting against the glass container industry, there has been a parade of witnesses. Two of the most important; not only as to their testimony but also with respect to their status in the industry, were William E. Levis, president of the Owens-Illinois Glass Co., and J. Harrison McNash, president of the Hazel-Atlas Glass Co. The story these men told of their business affairs and the manner of the telling, made such an obviously favorable impression that neutral observers felt a dent had been made—perhaps a heavy one—in the allegations against the defendants.

High-spot of the past month of trial was the story of Mr. Levis, which was told through his oral testimony, through letters and documents confiscated from the files of his firm, and by the direct examination of his own counsel. His testimony began with a bang. He made it clear that he was a bottle manufacturer and his principal aim during his early years was to place complete emphasis upon that work, to the exclusion of the licensing for royalty method of producing income. Samuel S. Isseks, Government counsel, was skeptical of the statement and challenged Mr. Levis to "produce just one single sheet of paper" upon which Mr. Levis had recorded such thoughts prior to the TNEC investigation in 1938.

This came at the close of Mr. Levis' first day on the stand. The following morning found Mr. Levis handing to Mr. Isseks an excerpt from a report to stockholders in 1931 in which he advocated exactly as he had testified. Sharp words had preceded this exchange and the outcome seemed to leave the special assistant to the attorney general out on a limb.

Numerous merger transactions, many of which never passed the negotiation stage were brought up by the Government. Mr. Levis admitted his part in each of the conferences, stating that on some occasions he "pulled the stroke oar." This quotation was offered after Mr. Isseks had insinuated a particular transaction was "framed" by Mr. Levis.

With equal frankness Mr. Levis admitted that he had sat on the board of directors of the competing Hazel-Atlas Glass Co., at the same time that he headed the Owens-Illinois Glass Co. This was by virtue of the fact that he was president and fiduciary for the Illinois Glass Co., an investment trust, after it had sold its tangible assets to the former Owens Bottle Co., in a merger deal in 1929.

Mr. Levis also explained that the Illinois firm had made an investment in the shares of the Thatcher Manufacturing Co. The glass industry was the field in which Mr. Levis said he felt most qualified to make investments for himself, other members of his family, and former employes, all of whom looked to him for leadership.

Stability in the glass industry, which had been beset by demoralizing patent litigation for years, was his aim, Mr. Levis said. The Government has seized upon the word "stability" as reflecting the condition which it claims is an illegal monopoly. Mr. Levis, however, contended that his aim was to "lower costs of manufacturing glass containers so as to place them upon a better competitive basis in comparison with other types of containers, specifically paper and tin."

Mr. Levis resigned from the board of Hazel-Atlas in 1935 due to possible embarrassment as a result of the reading into the Congressional Record by the late Senator William E. Borah of a letter about conditions in the glass industry. On examination by his own lawyer, Mr. Levis said he subsequently made an investigation and learned that the letter read by Senator Borah had been sent anonymously.

Flat denial was made by Mr. Levis to a charge by the Government that he was interested in arranging a "feeder machine pool" in 1933, through the purchase by the Lynch Corp. of the Ed. Miller Machine Co., of Columbus, Ohio., and also the O'Neill Suction Machine Co., of Toledo. Mr. Levis admitted that the Owens-Illinois Co., Hartford-Empire Co., and a financial plan arranged by him, had enabled Lynch to acquire the Miller firm.

J. Harrison McNash, president of the Hazel-Atlas Co., likewise made a fine impression while he was on the witness stand. He told of his having entered the firm as an office boy in 1903 and having worked his way to the top by gradual steps. Mr. McNash described with great clarity the "patent war" which preceded his firm's taking a license from the Hartford-Empire Co., in 1932. He denied any part in an alleged scheme to drive competing firms out of business and held that the fact that his firm was collecting one-third of Hartford's net income to be entirely proper in view of the fact that Hazel-Atlas had contributed many valuable patent developments.

Judge Kloeb has under advisement a motion by the Government which seeks to impound for the duration of the present litigation all exchange of funds by Hartford-Empire and Hazel-Atlas under the 1932 contract. Payments by the two firms to each other totaled more than $2,500,000. Should the judge grant the motion this entire sum would be taken out of the businesses of the two firms. Defense attorneys argued that it would work a hardship upon them and serve no useful purpose.

An interesting story was told in one memorandum, admitted during the testimony of Henry Carter, former Owens vice president and patent attorney. It described "an inspection trip" by L. D. Soubier, Owens inventor, to the plant of the Knox Glass Co., Knox, Pa., in 1928, when major firms in the industry suspected the Knox concern of infringing on the Owens patent rights. Mr. Soubier described in graphic language how he and an associate, alleged to have been employed at various times by Hartford-Empire Co., climbed to the roof of the factory in near zero weather, nearly slid off, cut a hole in the roof, and watched the machine operate. Unable, however, to get a good look Mr. Soubier boldly walked into the factory, stood beside the machine and watched it operate for a while, but finally was detected and recognized as an Owens representative and politely asked to "evacuate"—quotation from the testimony of R. R. Underwood, president of the Knox firm.

George E. Day, a Detroit attorney, testified that he made an unsuccessful attempt in 1935 to obtain a glass manufacturing license for a syndicate of brewery owners in Detroit. (*Continued on page* 225)

A.S.T.M. COMMITTEE OFFERS DEFINITION OF GLASS

A group of glass technologists met the last week in April and agreed upon the formulation of a definition of glass. These men compose sub-committee 1 of Committee C-14 (on Glass and Glass Products) of A.S.T.M., and their conclusions are the result of two years of study and correspondence.

The meeting was held at Cove Point, Md., where the first two Fall Meetings of the Glass Division made history in 1929 and '30. Present were: G. W. Morey, Geophysical Laboratory, chairman of Committee C-14; F. C. Flint, Hazel-Atlas Glass Co., chairman of sub-committee I on Nomenclature and Definitions; W. R. Lester, Maryland Glass Corporation; S. R. Scholes, N. Y. State College of Ceramics; and F. J. Williams, National Lead Co. Research Laboratory. A. N. Finn, Bureau of Standards, unable to attend, added his written suggestions.

Glass has always been glass, and for centuries its name has had a specific meaning which was at once easy to understand and difficult to define. However, in the last few years, other materials have come into being which have been permitted to share, because of superficial resemblances, the name of glass. Dictionary definitions of glass have been unsatisfactory, because they have merely named some of the properties of the material, or have given too narrow a view of glass by reciting bits of inaccurate chemistry.

The old writings, beginning with the ceramic notebooks of Nebuchadnezzar's glassmaker, attest the antiquity and individuality of glass without defining anything but its source. Pliny's familiar apocryphal account ("Natural History," about 50 A.D.) mentions fire, sand, and alkali prominently in the alleged discovery of the "ancient art." H. de Blancourt ("The Art of Glass," 1699) tells of glass, which "melts in the fire without consuming," but all of his quaint descriptive and laudatory sentences do not add up to a sound definition.

An early dictionary maker (N. Bailey, London, 1724) was not in the confidence of glassmakers, for he said, "Glass, a transparent substance artificially made of flints, sand, ashes, etc.". Another writer ("Body of Arts," 1753) tries his hand at definition: "Glass, a transparent, brittle, factitious body, produced of salt and sand by the action of fire."

As later attempts at making definitions became frequent and numerous, such words as "vitreous" and "vitrifiable" were used. If these are given their simple meaning of "glassy" and "glass-forming," the fact emerges that the lexicographers have been guilty of defining words by using synonyms; and, in covering the term "glass," they have not followed the logical genus-and-species route to true definition. Even the modern dictionaries, in this respect, are insufficiently inclusive and exclusive. (See GLASS INDUSTRY, Feb. 1941, p. 64.)

In developing the definition of glass, the committee had in mind certain necessities: (1) Brevity; no encyclopaedic account was intended. (2) Breadth; compositions are neglected, except in the classification. (3) Simplicity; words too technical for common usage or inclusion in desk dictionaries are avoided. (4) Emphasis on fundamentals; earthy source, fusion, and lack of crystals are the age-old characteristics of glassmaking.

The new definition and classification of glasses will be offered for adoption by Committee C-14. Upon its acceptance by the American Society for Testing Materials, it will become standard for this group of engineers, chemists, and physicists, whose standards and specifications have authority in all branches of industry. The reader will recall that the glass committee's methods for polariscopic examination, thermal-shock testing, and hydrostatic-pressure testing of glassware have already been adopted as tentative standards.

The Proposed Definition

"Glass is an inorganic product of fusion which has cooled to a rigid condition without crystallizing. Some glasses contain non-glossy material, always embedded in a glassy matrix. Glasses may be colored by suitable material in a dissolved or dispered condition.

"Glasses may be classified as:

A. One-component glasses, consisting of single oxides, such as silica, (SiO_2), boric oxide, (B_2O_3), or phosphoric oxide, (P_2O_5).

B. Two-component glasses, of which the chief commercial representatives are the soluble silicates.

C. Multi-component glasses:

1. Soda-lime-silica glasses, which include the great bulk of commercial glassware.

2. Borosilicate glasses, which range from soda-lime-silica glasses containing small amounts of boric oxide to low-expansion glasses containing little or no soda or lime.

3. Special glasses:

(a) "Flint" glasses, containing lead oxide, (Pb0), ranging from lead tubing and cut glass, to heavy lead glasses used for optical instruments and imitation jewelry.

(b) Optical glasses, mostly silicate or borosilicate glasses distinguished by physical perfection and a wide range of optical properties.

(c) Non-silicate glasses, used for special purposes and at present of limited commercial applicability."

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INVENTIONS AND INVENTORS

Summary of United States Patents of Interest to the Glass Industry Issued During March

Compositions

An interesting chapter in the glass plant operator's continued effort to utilize cheap rock salt in place of soda ash is revealed in Wm. S. Rendall's patent 2,234,605 (Crown Cork & Seal Co.). To take advantage of the substantial difference in cost of these raw materials Rendall provides an operation in which (1) the reaction and melting of the glass-making ingredients takes place in a closed steam-filled chamber separated from the atmosphere of combustion, (2) chlorine released from the salt is recovered, and (3) the glass is reduced to a frit capable of being converted to glass by remelting. One scheme of operation is shown in Fig. 1.

Furnaces

The apparatus of Fig. 2 for controlling forehearth circulation in a suction gathering process was patented by Clarence C. Kinker of Montreal, (2,234,147, Owens-Illinois Glass Co.). He was particularly concerned with the fact that the outer cavity of a plural cavity mold tends to draw cooler and more viscous glass than the inner cavity. The differences in temperature are caused primarily by the different paths of travel of the glass in the forehearth. The portion of the stream in the vicinity of the outer lip of the forehearth has a greater distance to travel and being in more intimate contact with the forehearth wall, is more readily chilled. As shown in Fig. 2, Kinker attacked the problem by providing an adjustable refractory baffle 20 which speeds up circulation of the hot glass in the outer regions of the forehearth. The adjustability of the baffle makes it possible to alter the flow of glass to meet changing conditions.

Feeding, Forming and Shaping

A machine for blowing narrow necked bottles, designed primarily for hand operation, is described in patent 2,235,103 granted to Charles B. Garwood, Linthecum Heights, Md. (Carr-Lowrey Glass Co.). The blank is subjected in rapid succession to a settle blow and a counter blow so timed that the glass has no opportunity to chill noticeably between them, and then the completion of the parison is effected without the production of the objectionable "settle blow wave" which Garwood states is pronounced in bottles previously produced by the settle blow and counter blow method.

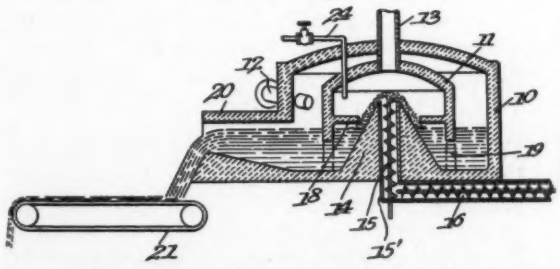


Fig. 1. 2,234,605: Rendall. In producing a fritted glass batch utilizing rock salt instead of soda ash, center fed materials are melted by radiation in chamber 11 which is separated from the combustion chamber. The product is remelted in a subsequent fining operation.

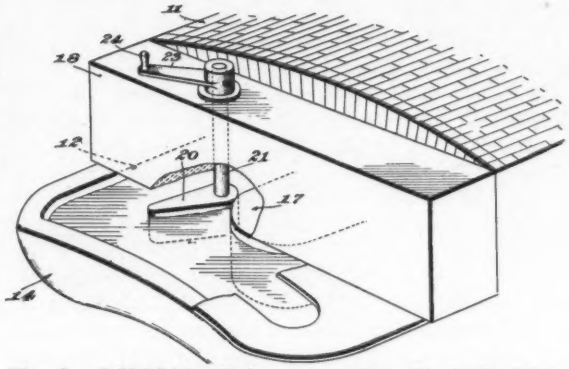


Fig. 2. 2,234,147: Kinker. An adjustable baffle 20 in the forehearth alters the flow lines of glass to prevent excessive chilling at the outer wall.

Jakob Dichter of Berlin-Schoneberg, Germany has patented a machine (2,234,302) for forming inner threads on glass containers. Means are provided for heating one end of a glass tube, inserting a threaded plug by cam action, and applying a pair of rollers to the outside of the tube to force the softened glass against the threaded plug.

Patent 2,235,359 granted to Geo. L. Curry, Pawtucket, R. I., and Albert N. Smith, Wellsboro, Pa., (Corning Glass Works) describes an improvement in the method of operating a ribbon type illuminating bulb machine. The objective is to decrease loss of ware due to defective break-off when the bulb is severed from the ribbon. Details of operations are shown in Fig. 3.

Means for shaping and affixing the base to a tumbler are described in Libbey Glass Co.'s patent 2,235,129 granted to Chas. R. Vining of Elmore, O., and Irvin C. Hamilton, Toledo. The base is shaped and simultaneously attached to the tumbler in a continuously rotating machine.

Two patents for feeding mechanisms for rotary mold-

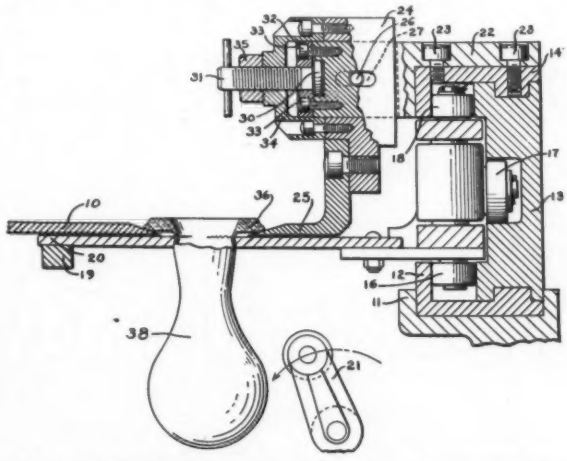


Fig. 3. 2,235,359: Curry & Smith. Crack-off of bulbs from ribbon 36 is accomplished by striking the bulb conventionally by arm 21 while lifting the ribbon simultaneously from two sides by lifters 10 and 25, while the orifice plate 20 holds the bulb.

ing machines were received by Owens-Illinois Glass Co. These were 2,235,111 to Joseph B. Potoczky, Toledo, and 2,235,222 to John Lauterback, Philadelphia.

Cellular Glass

Two additions were made to the important group of Pittsburgh Plate Glass Co. patents on the manufacture of cellular glass. Some processes previously disclosed for distributing gas cells within a glass mass, involve the addition of gas-forming compounds to molten glass. Even distribution of the cells or bubbles is difficult to obtain. In the latest patent 2,233,631 granted to Robert A. Miller, Tarentum, Pa., and Wm. O. Lytle, New Kensington, Pa., a fluid such as a gas is forced through the walls of a porous mold into a body of molten glass. The second patent, 2,233,608, to Lytle and Elmer H. Haux, Tarentum, discloses the addition of porous material such as vermiculite to the glass prior to the introduction or development of gas cells. In the finished product the vermiculite would be embedded in the walls of the individual cells. The presence of the porous grains is said to alter the properties of the glass.

Miscellaneous Processes

Donald G. Merrill's patent 2,233,629, assigned to Hartford-Empire discloses apparatus and methods for controling the temperature through lehrs having burners so arranged and operated as to provide a circulatory gas movement. Since the gas or air circulation is governed by the velocity of the combustion gases, a turn-down of the burners carries with it a decrease in circulation activity. Since this may be undesirable, Merrill provides a means of introducing atmospheric air in separate jets at points near the burners.

Plate and Sheet Glass

A continuous sheet mirror producing development of major importance was described in Wm. O. Lytle's patent 2,233,622 (Pittsburgh Plate Glass Co.). The reflecting surface is produced by applying a metallic oxide of silver, aluminum or tin to the red hot surface of a sheet of glass as it is being passed through a horizontal rolling machine, and by maintaining a reducing atmosphere to convert the oxide to a metallic film. Fig. 4 illustrates one example. The oxide, which may be applied by vibration as a frit, is spread over the sheet in an even layer, rolled into place, and thereafter reduced.

Another decorative process assigned to Pittsburgh

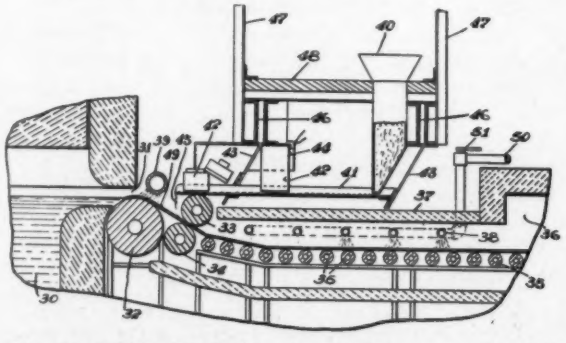


Fig. 4. 2,233,622: Lytle. A continuous mirror producing process in which metal oxide is applied at 45 onto the surface of a newly formed sheet.

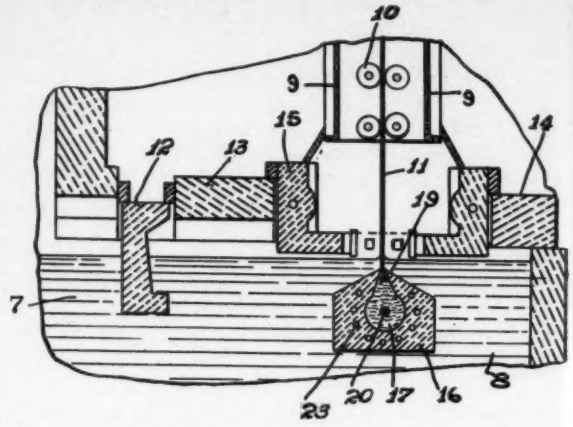


Fig. 5. 2,233,597: Fox. Flashed sheet glass with a colored core is made in a standard machine by providing a side-fed reservoir 17 of colored glass. Heating elements 20, 23, maintain the latter in proper condition for drawing.

Plate Glass Co. is described in patent 2,233,597 which discloses a method devised by John H. Fox of Pittsburgh for making colored sheet glass. This is a so-called "flashed glass" which has a central layer of colored glass with outer integral coatings of clear glass. The invention is easiest explained by referring to Fig. 5 which shows the application of the Fox process to an ordinary sheet glass machine. Element 16 is a container to which molten colored glass is supplied at the side of the tank by means not shown in this drawing. The sheet 11 which is drawn from the batch consists substantially of clear glass, which is supplied from the bath in the forehearth, but there is a central layer of colored glass drawn upward from the chamber 17. An advantage of this process is the ease with which the entire coloring unit can be removed from the furnace to allow normal sheet glass to be made.

Earl L. Fix of New Kensington assigned to Pittsburgh Plate Glass Co. patent 2,233,941, for a multi-layer nonglare safety glass utilizing layers of vinyl acetal resin and a cellulosic material containing polarizing particles.

In connection with the current increased interest in electric glass melting, attention is frequently directed to the work of Edouard V. Borel, Romon, Switzerland, whose patents are assigned to Société Anonyme des Manufactures des Glaces et Produits Chimiques de Saint Gobain, Chauny & Cirey, Paris, France. His latest invention, as disclosed in patent 2,236,231, has to do with the avoidance of chilling which might cause devitrification in the space between the furnace walls and the normal delivery device in the Fourcault process. He places electrodes in various ways to overcome such difficulties and may even make the slot of the delivery device of properly conductive materials.

In a group of four patents assigned by their inventors to Libbey-Owens-Ford Glass Co. were two concerned with laminated safety glass. Geo. B. Watkins of Toledo provided a technique in patent 2,236,046 for the use of a "flowed on" plastic layer rather than a preformed sheet. To prevent the formation of bubbles it would usually be necessary to drive off excess solvent before applying the second sheet of glass. Watkins reports that the temperature of the glass when the plastic is applied is

very important, and his principal claim to invention rests on temperature control practices. He finds it advisable to have the glass at a lower temperature than that of either the air or the plastic. This minimizes the tendency for solvent to vaporize from points near the glass surface to form bubbles. Instead the solvent vaporizes from the more remote plastic service.

The second Libbey-Owens-Ford laminated glass patent is concerned with the rolling operation for permanently bonding both sheets of glass to a plastic layer. The inventor, James H. Boicey of Toledo intends that his process as outlined in patent 2,235,958, shall make it possible to eliminate the autoclaving process which ordinarily follows the rolling process. Usually the rolls provide only a relatively light nipping action, and Mr. Boicey states that earlier processes have run into difficulties because the plastic intended excessively to be forced out at the edges. To overcome this feature the invention utilizes protective spacer strips as shown in Fig. 6.

Gerald White of Toledo assigned to Libbey-Owens-Ford his patent 2,235,969 for an apparatus suitable for bending tempered safety glass. The sheet held in the tempering furnace is shaped to rounded form between male and female forms which contain small outlets through which the blasts of air subsequently issue to complete the temper.

The fourth Libbey-Owens-Ford sheet glass patent was 2,236,011 granted to Harry C. Shock of Charleston, Ohio, for apparatus for cracking off and handling previously scored sheets.

Another group of five Libbey-Owens-Ford patents refers to structural uses of glass. Building units were detailed in patents 2,235,113-2, 235,114 and 2,235,115 granted to Erle T. Putnam of Detroit. Charles D. Haven and John J. Hopfield of Toledo received patents 2,235,680 and 2,235,681 for multiple glass sheet glazing units.

Glass wool and Fibers

Adolf Dietzel of Berlin-Zehlendorf, Germany, produces glass filaments, according to patent 2,234,521 by flowing molten glasss onto an inclined rotating rod from the lower end of which jets of air issue continuously to blow away the glass.

The five remaining patents in this group were assigned to Owens-Corning Fiberglas Corp. Of more than ordinary interest is 2,234,087 which was applied for almost ten years ago. The inventors, Friedrich Rosengarth and Fritz Hager, both of Germany, flow a thin stream of molten glass or slag onto a rapidly rotating disc from which it is thrown off

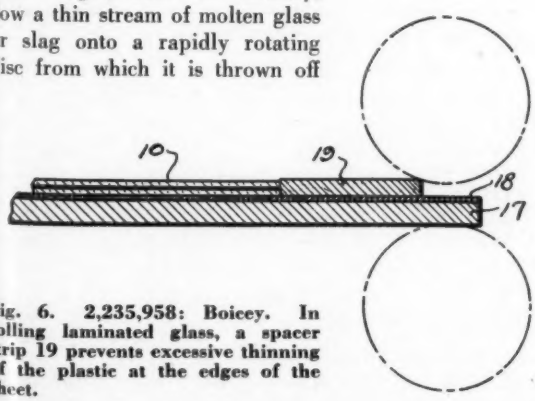


Fig. 6. 2,235,958: Boicey. In rolling laminated glass, a spacer strip 19 prevents excessive thinning of the plastic at the edges of the sheet.

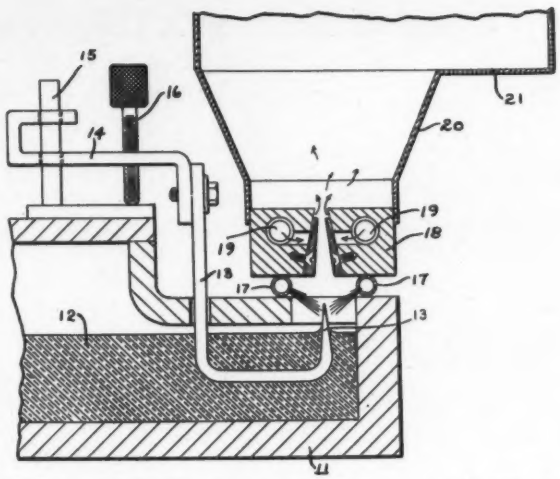


Fig. 7. 2,235,352: Bates. The platinum comb, 13′, elevates thin films of glass to a field where burners 17 supply intense heating, and steam blowers 19 create a partial vacuum to draw fine fibers.

centrifugally to form fibers. A downward blast of air is used to aid the fall of the fibers. Other patents have disclosed the centrifugal method of forming glass fibers but the early filing date of this one (No. 16, 1931), and its fairly broad claims, suggest that it may occupy an important position in the fiber industry.

Harry V. Smith of Newark disclosed, in patent, 2,233,433, several means of making nodulized glass wool. Typically a mat of fibers is coated with a thin layer of free alkali, and then is reduced to chunks and the chunks rolled into nodule form.

The familiar platinum lined V-shaped feeding trough by which glass wool fibers are drawn from the bottom of a melting furnace are replaced by other means to save expense, in patent 2,235,352 granted to Harry C. Bates of Corning. As shown in Fig. 7, his process substitutes a vertical drawing process. The essence of this process is Bates' discovery that a comb-like feeder can be used to elevate films of glass into an intensely heated field from which steam blowers will initiate a drawing action which will yield extremely fine continuous fibers.

Textile glass fiber of high strength, stretchability and flexibility are said to be produced by methods outlined in patent 2,234,986, granted to James Slayter and John H. Thomas of Newark. This patent is a continuation in part of their patent 2,133,236 which issued in 1938. While extensive details of technique are described, the crux of the invention is the provision of many orifices in the bottom of a feeding trough from which fibers are drawn by blasts applied to more than one side of the fibers.

The use of marbles as glass stock for fiber-producing furnaces is a common practice which aids in the elimination of bubbles and seeds. Henry Snow of Newark reports in patent 2,233,435 that very great advantages are gained by tempering these marbles so as to provide a surface compression. This is said to greatly alter the melting characteristics. The tempered marbles merely slump and merge into the supply body of glass, whereas untreated marbles may crack or "crizzle" to carry gases into the glass.

CURRENT STATISTICAL POSITION OF GLASS

During March activity in the glass industry was greater than any previous month in history. Production was at a record level, employment and payrolls were at all time highs, and exports approached a new peak. According to THE GLASS INDUSTRY'S Production Index, manufacturers attained a production volume of $36,000,000 during March. This compared with less than $30,000,000 in March 1940. During the first quarter of 1941, glass production totalled $102,000,000, which indicates that glass plants are operating at about 20 per cent above last year's level.

Plate glass production during March totalled 18,266,432 square feet according to the Plate Glass Manufacturers of America. This represented an increase of 17 per cent over the February total and exceeded the volume reported for March of last year by 28 per cent. During the first quarter of 1941, plate glass output amounted to 53,281,000 square feet, which was a new record for this period of the year, having increased 19 per cent over the 1940 figure.

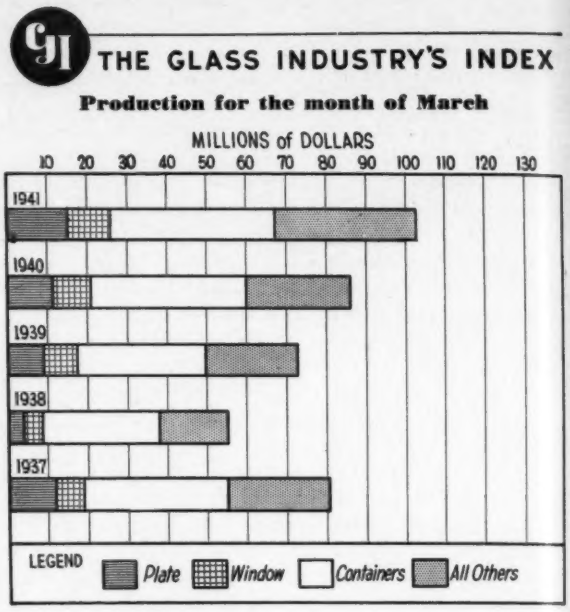
Window glass production during March increased 1 per cent over the February figure to 1,416,869 boxes. This was a new March record, having risen 28 over last years comparable total. During the first quarter of 1941, window glass output totalled 4,375,000 boxes, breaking all previous first quarter totals; last year's first quarter production was 3,619,000 or 22 per cent less than this year's figure.

Glass container production during March totalled 5,127,990 gross according to the Glass Container Association of America. This was the greatest monthly volume the industry has produced since August 1937. It was 19 per cent greater than the February total and exceeded March 1940 by 11 per cent. During the first quarter of 1941 glass container production totalled 14,012,691 gross which was 8 per cent above the 1940 level.

Shipments of glass containers during March amounted to 5,116,859 gross—another record figure. This was 21 per cent more than the March 1940 volume. All type of containers moved in larger quantities but greatest gains were reported for domestic fruit jars (up 169 per cent), beer bottles (up 83 per cent), general purpose ware (up 37 per cent), milk bottles (up 25 per cent) and liquor ware (up 23 per cent). Total shipments for the first quarter of 1941 amounted to 11,795,977 gross—a gain of 15 per cent over last year. Here again domestic fruit jars led the industry gains, percentage-wise, with an increase of 220 per cent. Beer bottle shipments expanded 43 per cent over last year's first quarter, pressure and non-pressure ware and general purpose ware 27 per cent and pressed food jars and milk bottle 19 per cent.

Stocks of glass containers in the hands of manufacturers at the end of March totalled 9,979,020 gross which was 2 per cent less than the March 1940 figure. This was largely traceable to declines in liquor, beer and milk bottle inventories; stocks of food containers, pressure and non-pressure ware and general purpose ware were above the 1940 level.

Miscellaneous glass products produced during March had a value of $12,000,000 according to reliable estimates. This compared with $11,000,000 in February and $9,000,000 in March of last year. During the first quarter of 1941, this branch of the glass industry had a



CURRENT GLASS CONTAINER STATISTICS

(ALL FIGURES ARE IN GROSS

Types of Ware	Production March, 1941	Production March, 1940	Shipments March, 1941	Shipments March, 1940	End of Month Stocks March, 1941	End of Month Stocks March, 1940
Food Containers (Narrow neck, wide mouth and pressed)	1,348,922	1,122,512	1,319,685	1,107,377	2,097,307	2,013,024
Pressure and non-pressure ware	460,584	383,005	411,897	356,079	1,045,429	877,291
Beer Bottles	406,452	319,182	368,054	205,850	819,220	1,053,122
Liquor Ware	742,037	683,127	843,280	690,896	1,511,291	1,470,097
Medicinal and Toilet Ware	1,482,806	1,533,165	1,493,411	1,359,812	3,060,314	3,141,635
General Purpose	419,352	322,341	434,384	317,549	599,098	509,346
Milk Bottles	214,489	194,369	213,015	170,301	294,040	333,451
Fruits and Jellies	30,396	31,583	12,981	6,073	514,607	642,459
All Others	22,952	19,592	20,152	15,028	37,714	37,962
Industry Total	5,127,990	4,608,876	5,116,859	4,228,965	9,979,020	10,078,387

production of $34,000,000—an increase of 25 per cent over 1940.

Production of machine-made tumblers during March increased 7 per cent above the 1940 level to 4,200,218 dozens. This brought the first quarter total up to last year's level of 11,094,804 dozens. Shipments of this ware during March showed an expansion of 16 per cent to 4,424,262 dozens so that during the first 3 months of 1941 a total of 11,069,587 dozens were shipped as compared to 10,453,110 dozens in 1940. Stocks of machine-made tumblers as of March 31 amounted to 8,115,538 dozens—6 per cent above last year's level.

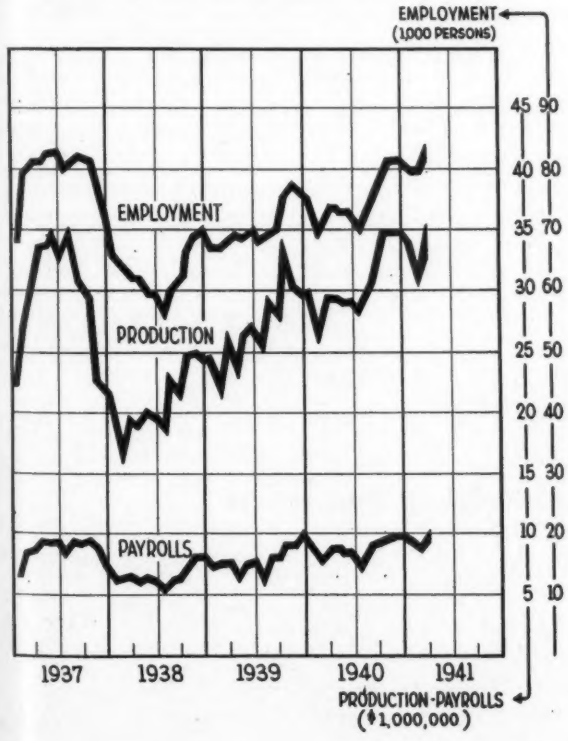
Manufacturers sales of machine-made table, kitchen and household glassware were reported to have been 3,400,343 dozens during March which represented an increase of 18 per cent since last year. During the 12 month period ending March 31, 1941 this trade totalled 33,505,436 dozens.

According to a preliminary release of the Bureau of the Census 12 illuminating glassware manufacturers reported sales totalling $742,000 during March which was 33 per cent more than their March 1940 business and represented a 9 per cent rise since February.

Employment and Payrolls: Approximately 83,800 persons were employed in the glass industry during March. This was the greatest monthly employment figure on record representing an increase of 3,500 persons over the February figure. In March 1940, 74,000 persons were employed in the manufacture of glass and glass products.

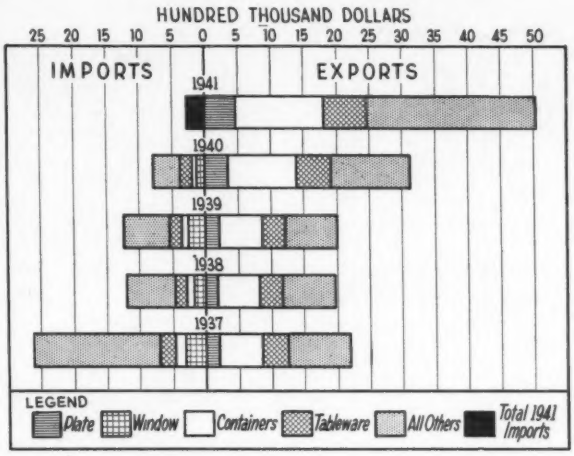
GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through March, 1941



GI THE GLASS INDUSTRY'S INDEX

Foreign Trade for March



Payrolls in the glass industry were at an all time high, also, with total wages estimated at $10,300,000. During the first quarter of 1941 glass manufacturers paid their employees over $29,000,000 as compared to less than $25,000,000 in last year's comparable period.

Foreign Trade: Exports of glass and glass products during March totalled $1,829,000 which was 12 per cent more than the February figure and exceeded March of last year by 67 per cent. All types of ware were expected in greater amounts with largest percentage increases reported for window glass (up 900 per cent); plate glass (up 62 per cent) and illuminating ware (up 28 per cent); containers increased 21 per cent and tableware 8 per cent. During the first quarter of 1941 exports totalled $5,045,000 which was 61 per cent more than the comparable 1940 figure of $3,096,000.

Imports of glass and glass products had a value of $115,000 during March which was 64 per cent below last year's comparable total but exceeded February by 20 per cent. During the first three months of 1941 imports amounted to $310,000 as compared to $767,000 in 1940's first quarter.

UNITED STATES FOREIGN TRADE IN GLASS
(Values in Thousands of Dollars)

Exports	*Mar.* 1941	*Feb.* 1941	*Mar.* 1940
Plate glass	148	182	92
Window glass	246	156	25
Containers	463	440	382
Tableware	213	235	199
Illuminating ware	73	69	56
All other	686	552	346
Total	1829	1634	1100
Imports			
Total	115	89	318

• The Glass Container Association of America will hold its annual spring meeting at The Homestead, Hot Springs, Va., on Thursday and Friday, May 15 and 16. A meeting of the Board of Directors will precede the general meeting on Wednesday.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite)			
90%, 99% through 200 mesh	ton	43.00	46.00-49.00
Reduction on precipitated material, $5.00 a ton		45.00	50.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)	lb.	....	....
Granulated	In bags, lb.	.0215	.027 -.0295
Powdered	In bags, lb.	.024	.0295-.032
Boric acid (H_3BO_3) granulated	In bags, lb.	.048	.054 -.0565
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al F_6$) Natural Greenland (Kryolith)	lb.	.0865-.0875	.0925
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	29.00	....
In bags	ton	30.60	40.00-42.50
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0825	....
In 5 Ton lots	lb.	....	.0875
Less than 5 Tons	lb.	....	.0925
Lime—			
Hydrated ($Ca(OH)_2$-MgO) (in paper sacks)	ton	8.50	8.50
Burnt (CaO-MgO) ground, in bulk	ton	7.00	....
Burnt, ground, in paper sacks	ton	9.00	9.00
Burnt, ground, in 180 lb. drums	Per drum	1.60	1.70
Kiln Dried ($CaCO_3$-$MgCO_3$) 10x30 mesh	ton	1.75	....
Kiln Dried ($CaCO_3$-$MgCO_3$) 16x120 mesh.	ton	1.75	....
Nepheline Syenite, f. o. b. shipping point	ton	12.00	15.00
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.065	.0675
Hydrated 80-85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags	ton	18.00-20.00	25.00
in bulk		16.50	
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb	.95	....
In barrels	Per 100 lb.	1.35	....
In bags	Per 100 lb.	1.10	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls	Per 100 lb.	....	2.50-2.90
95% and 97%			
Bulk	Per 100 lb.	1.35	....
200 lb. bags		1.44	1.465
100 lb. bags		1.475	1.50

Special Materials

		Carlots	Less Carlots
Aluminum hydrate (Al $(OH)_3$)	lb.	.026-.029	.04
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.13	.13½
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03½	.04½
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	9.00	12.00
Sodium fluosilicate (Na_2SiF_6)	lb.	....	
Tin Oxide (SnO_2) in bbls	lb.	....	Open price.
Titanium Oxide (ceramic grade)			
In bags	lb.	.13	.13¼-.13¾
In barrels	lb.	.13¼	.13⅜-.14
Zinc Oxide (ZnO)			
American process, Bags	lb.	.06½	.06¾
White Seal, 150 lb. bbls	lb.	.09	.09¼
Green Seal bags	lb.	.08¼	.08½
Domestic White Seal bags	lb.	.08¾	.09
Red Seal, bags	lb.	.07¾	.08
Zircon			
Refined Granular (Milled .01-.02c higher)		.06½	.07-.08

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40-1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.10-1.15
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls	lb.	....	.22-.25
Chromite (99% through 200 mesh)	ton	45.00	48.50
Chromite ore (air floated)	ton	55.00	58.00-73.00
Cobalt oxide (Co_2O_3)			
In bbls	350 lbs. or more, lb.	....	1.84
	Less than 350 lbs., lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.19-.21
Black (CuO)	lb.	....	.18½-.20
Black prepared	lb.	....	.24
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.05-.09½
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035-.05
Lead Chromate ($PbCrO_4$) in bbls	lb.	....	.13
Lithium Carbonate	lb.	....	1.25
Manganese, Black Oxide (Caucasian)			
In Paper bags	ton	70.00	78.00
In Burlap bags	ton	71.75	79.75
In Casks	ton	74.00	82.00
Neodymium oxalate, 50 lb. drums	lb.	....	4.00
Nickel oxide (Ni_2O_3), black	lb.	....	.35-.40
Nickel monoxide (NiO), green	lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.08¾	.09-.09¼
Powdered	lb.	....	.09¼-.09¾
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.21-.25
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¾	.07-.07¼
Sodium chromate (Na_2CrO_4) Anhydrous	lb.	.08¼	.08¼-.08½
Sodium selenite (Na_2SeO_3)	lb.	....	1.50-1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.65
Yellow	lb.	....	1.65
Sulphur (S)—			
Flowers, in bbls	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls	Per 100 lb.	2.90	3.25-3.65
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	....	2.55
Yellow orange	lb.	....	1.65

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.072	.08
Pumice Stone,			
American Ground Italian FFF, FF, F	lb.	.... }	open price
0, 0½, ½, 1.	lb.	.... }	
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	02¼	.03½
Rouge, Red	lb.	....	.16
Black	lb.	....	.18

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COLONIAL ESSO'S "CALORIA"

A lubricating oil which does its work, then vanishes without a trace, is being introduced by the Colonial Esso Marketers to industries faced with problems of lubrication at extreme temperatures. The new oil, known as Caloria, is the first petroleum lubricant to embody the characteristic of complete disappearance at high temperature. It is designed to solve the old problem of lubrication under intense heat, such as is found in kiln cars, glass making machinery, ceramics and glass molds, annealing and baking ovens, working parts of die casting machines, and various hot parts of machines in the metal industries.

In addition to its ability to disappear completely under high heat, Caloria spreads to only four or five times its original area, assuring that it will remain in greater quantity and for a longer time on bearing surfaces. Conventional oils spread over many hundred times their original area when dropped on a surface heated to 400°F.

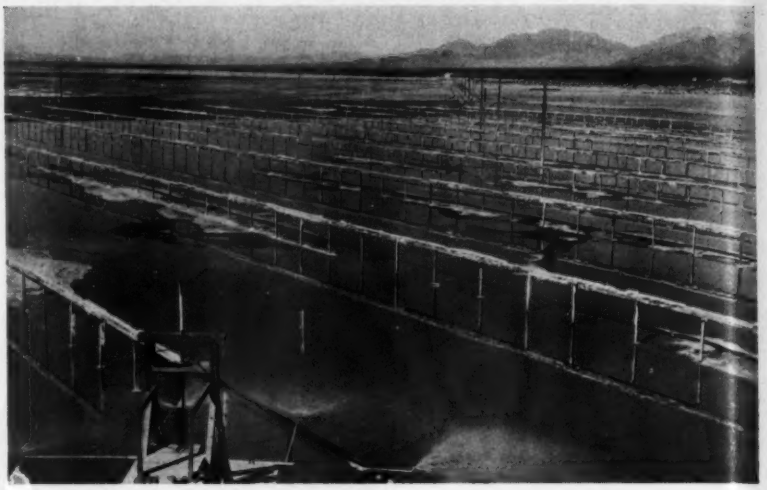
For use in cases where Caloria cannot be re-applied before complete evaporation takes place, the use of Van Caloria, which incorporates colloidal graphite, will cause a dust-thin layer of graphite to remain after the complete disappearance of the petroleum lubricant.

RESPIRATOR GOGGLE

A new goggle, designed by Bausch & Lomb, provides complete eyesight protection for workmen engaged in operations where respirators must be used, but where the hazard is not great enough to require a complete helmet. This metal frame spectacle goggle is cut away in the nasal portion so that it fits close to the face, yet leaves sufficient room for the respirator. The special lens shape was developed at the instigation of one of the country's largest paint manufacturers and has solved the difficult problem of providing eyesight protection where respirators are used. The construction provides a lightweight, rigid frame and is supplied in a variety of sizes. The goggle is offered with wire mesh or with either clear or green acetate nose and side shields. The nose shields provide extra protection from splashes and flying objects coming from in front of the workman. The goggles are available with either plano or prescription hardened lenses and can be used frequently in place of heavier and more cumbersome models.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.



A view of Desert Chemical Company's evaporating lakes.

CLARK "ANGLE" COMPRESSOR

A line of steam driven "Angle" compressors has been developed by Clark Bros. Co., Inc., of Olean, N. Y., based on their right angle design of gas engine driven compressors. The new compressors have three to six power cylinders and a corresponding number of compressor cylinders in practically any arrangement desired.

The power ends of these units are equipped with Unaflow steam cylinders and are noted for their economical operation. The particular features of this compressor are small floor space requirements, low foundation and building costs, economical steam rates, flexibility and minimum maintenance costs due to the smallness of the parts. The "Angle" compressors can be furnished in sizes from 600 to 4000 H.P.

CATALOGS RECEIVED

Surface Combustion Corp., Toledo, Ohio. A booklet, "Heat and Glass," describing and illustrating the various types continuous annealing lehrs, radiant tube fired decorating lehrs, direct-fired decorating lehrs, special process furnaces, batch type lehrs and ovens, convexing and bending furnaces, recuperative tanks, burner equipment and engineering service of the company.

Metallizing Engineering Co., Inc., Long Island City, N. Y. Bulletin No. 42, "Metco Metallizing Equipment and the Metallizing Process." The 16 page bulletin describes the application in industry where the Metco process can be used for rehabilitating worn shafts and other rotating machinery, as well as protecting metal surfaces against corrosion and other chemical attack. The new Type 2E "Controlled Power" metal spray gun and the standard Type E are described.

Wright Austin Company, Detroit, Mich. A new trap for draining moisture and oil from all kinds of compressed air equipment is described in a circular (No. 265) just issued by the company. The No. 23-AC trap is a simple float type and is made for long and dependable life on compressed air service. It is convenient to install, being of the straightline, horizontal type, and all working parts are removable by simply lifting off the cover without breaking the pipe connections.

DESERT CHEMICAL OPENS

Commercial shipments of Glauber's salt mark the first quantity production of chemicals at the new plant of the Desert Chemical Company of Dale Lake, Cal. The first year's cycle is expected to produce 50,000 tons of anhydrous sodium sulphate, which is stated to analyze 99.5 per cent purity.

The operations bring into production an apparently unlimited supply of sodium sulphate, and demonstrates a "natural" process of recovery. A combination of temperature extremes with low relative humidity, a salt deposit containing only two chemicals (sodium sulphate and sodium chloride) that separate naturally by fractional crystallization, and an abundance of fresh water, makes possible the process used. Cold precipitates the sodium sulphate as Glauber's salt, which is re-dissolved and dehydrated in hot weather. The residual brine, containing sodium chloride, is evaporated in huge lakes. The limited area already completely proven by test wells shows about 12,000,000 tons of sodium sulphate, while the entire property is estimated to hold between thirty and thirty-five million tons.

TOLEDO TRIAL ENDS SECOND MONTH

(*Continued from page* 215)

Alexander D. Falck, chairman of the board of the Corning Glass Works, described his connections with the former Empire Machine Co., which later became a part of Hartford-Empire, and later with the latter concern.

Charles B. Belknap, vice chairman of the Board of Owens-Illinois, and also a patent attorney, testified that the famous "1924 General Licensing Agreement" between Hartford and Owens was his idea of escaping from an ensnaring amount of patent litigation. He described the patent situation at that time as "heartbreaking."

Paul L. Geer, secretary-treasurer of the Amsler-Morton Co., testified that he had been threatened in 1934 that unless he would "go along with us (Hartford and Owens) he would be sued and sued until he was out of business." His principal field was the manufacture of lehrs. He was defeated in subsequent patent litigation.

S. A. Coleman, Jr., of Port Isabel, Tex., described a venture in the glass manufacturing field which failed in 1934. He described his inability to procure a Hartford-Empire license to operate.

With eight weeks of testimony gone by the board, the Government appears to be near the close of its case. After the prosecution rests, Judge Kloeb will call a recess for perhaps a month, after which the defense will get under way.

POLARISCOPE FOR CLOUD PREDICTIONS

A new scientific method by which cloud formations can be predicted as long as four hours before they appear has been discovered by Dr. Hans Neuberger, instructor in geophysics at The Pennsylvania State College.

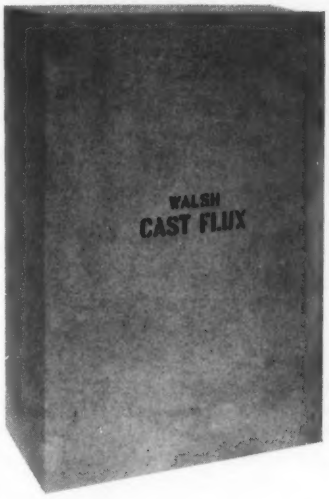
Describing his method as having potential auxiliary value in weather forecasting, Dr. Neuberger said it is based on atmospheric analyses made through a polariscope. This instrument detects the first signs of swelling in the condensation particles in the air showing that moisture is beginning to condense on the particles. When enough of these droplets are formed, clouds become visible. His report showed that volcanic eruptions often make the air "hazy" thousands of miles away. He detected traces of "haziness" at State College from eruptions that occurred in Alaska and Japan.

Dr. Neuberger's findings resulted from a two-year study at State College that was one of the most comprehensive of its type ever carried out. Dr. Neuberger had his polariscope built to specifications in the mineral industries laboratory on the campus.

"SALT OF THE EARTH"

The story of Captain John B. Ford and the Michigan Alkali Company, written by Arthur Pound and published by the Atlantic Monthly Company, Boston, is a well illustrated and bound volume of 17 chapters. Interesting highlights of Captain Ford's career and important details of the development of not only the Michigan Alkali, but the Pittsburgh Plate Glass Company and other enterprises are all related, including the story of how his sons, grandsons and great-grandsons have carried on after him.

WALSH CAST-FLUX



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DR. DAY AWARDED WOLLASTON MEDAL

The Geological Society, England, has awarded its highest honor, The Wollaston Medal, to Dr. Arthur L. Day for his researches in vulcanology and in the field of experimental petrology. Announcement of the award appeared in the February 8 issue of *Nature* as follows:

Dr. Day's name will always be associated with the Geophysical Laboratory of Washington, of which he was the distinguished director from its foundation in 1907 until his retirement thirty years later. In 1900, very early in his career, Dr. Day was called upon by the Geological Survey of the United States to equip a laboratory in which the exact methods of physical chemistry could be applied to the study of rock-forming minerals; and the following year, in collaboration with Dr. E. T. Allen, he began his famous investigation of the isomorphism and thermal properties of the felspars. This research may be said to have introduced a new era in mineralogy and petrology. It proved so successful that the Carnegie Institution of Washington decided to erect a special laboratory for the study and measurement with the utmost possible precision of the factors involved in the formation of rocks. Dr. Day became its director.

The immense progress that has since been achieved by Dr. Day and his enthusiastic band of colleagues—attested by more than a thousand publications—proves the wisdom of that happy choice. The researches have included the investigation of a wide variety of mineral systems of one to five components; of the effects of volatile constituents; of the effects of temperature and pressure on minerals and rocks; of crystal structure; of the production of schistosity; of the gases and gas reactions of active volcanoes; of the nature and origin of hot springs and geysers; of many natural assemblages of rocks and their geochemistry; of the radio-activity of rocks; and of many economic problems such as those connected with the manufacture of cement and optical glass. In some of these Dr. Day has himself taken the leading part, especially in the adventurous study of volcanic phenomena. Latterly he became attracted to the hot-spring problem, and to the results of his work in this difficult field he devoted his address to the Geological Society of America, of which he was elected president in 1938. Dr. Day has always been outstanding for his remarkable flair for devising successful experimental methods and apparatus. His own deep passion for "the rigour of the game" has established a tradition of high scientific accuracy which his colleagues have worthily upheld. Workers from many other countries have been trained in the famous Laboratory under his stimulating guidance and have returned to their home-lands to spread that tradition far and wide. Dr. Day's innumerable friends and admirers will feel that there could be no more appropriate recipient of the Wollaston Medal, awarded, as it is, to honor those who have made—in the words of the founder —"researches concerning the mineral structure of the earth."

• Commander Andrew G. Shepard and gunnery officer Lieutenant Commander Thomas B. Hill, of the new 35,000-ton battleship *North Carolina*, both did tours of duty at the Bausch & Lomb Optical Co. as inspectors of naval ordinance.

CLAUSE PRESIDENT OF P.P.G.

Robert L. Clause has been elected president of the Pittsburgh Plate Glass Co. He succeeds H. S. Wherrett, who will fill the newly created post of vice-chairman of the Board. Mr. Clause came to the company as a draftsman in 1914 and has served as assistant superintendent and as general superintendent of plate glass manufacture.

NEW CORNING LABORATORY DEDICATED

With the completion of its new laboratory building last month, the research facilities of Corning Glass Works have been doubled and are said to be now without equal in the world. The company is the world's largest producer of technical glass, which is used extensively in aviation, marine, railroad and signal corps work, and the headquarters plant at Corning is operating at full capacity, night as well as day. Because of the research facilities now made available by the new laboratory building and the concentration of defense work at this plant, the Corning laboratories is expected to become a focal point in glass research for national defense.

Appropriate to this situation, the dedication of the new laboratory building last month was a private affair, limited to a simple "dedication dinner," and with no public program.

Dr. J. T. Littleton, Assistant Director of Research, acted as toastmaster and speakers included Mr. A. D. Falck, Chairman of the Board; Doctor Sullivan, who is now Vice Chairman of the Board and Director of Research; Mr. Amory Houghton, President of Corning Glass Works, and Mr. George D. Macbeth, Vice President. Mr. Houghton, in his remarks, called attention to the progress which American industry has achieved through consistent support of the organized research. "We hope," said Mr. Houghton, "that our continuous expansion of research during the past three decades will fortify our contribution to the program of the glass industry in national defense. We hope also that the lessons of these present years of intensive production will provide values which can be applied when peace and reconstruction again occupy the minds of men throughout the world."

Dr. George H. Morey, Physical Chemist of the Geophysical Laboratory of the Carnegie Institution, at Washington, and Consultant to Corning Glass Works, pointed out that the production of glass in the United States is four times that of either of the two nearest competitors, the United Kingdom or Germany, and three times the total of Germany, Austria and Czechoslovakia. The United States' market for glass," Doctor Morey explained, "is equal to that of the rest of the world."

Dr. Sullivan was the special guest of honor. It was he, with two assistants, who came to Corning in 1908 and organized the laboratory, a pioneer in its field in America. At that time, the laboratory occupied 1200 square feet in a fourth-floor corner, now it occupies 61,000. Even more extension than this 50 to 1 ratio has been the increase in the laboratory staff, which has expanded in a ratio of 60 to 1.

• Pressed Prism Plate Glass Co. has closed its Chicago office. General offices of the company have been moved to the factory at Morgantown, W. Va. These changes are expected to result in closer contact between administration, sales, manufacturing and shipping departments.

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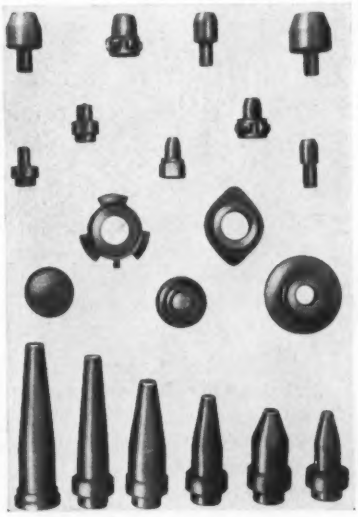

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CALCULATION OF DENSITY

In a recent paper[1], M. L. Huggins has assembled the published data on density of glasses, and reduced them to a formula which fits the experimental data as accurately as they are known. From this formula, therefore, the density of a glass can be calculated from its composition, and, although this is not an entirely satisfactory way of finding density, the use of Huggins' formula is the next best thing to measuring density.

Huggins has left the formula in a form which is unfamiliar to many glass men, and which is also rather awkward for routine computations. The following rearrangement will present it in a more usual form. Huggins' equation is

$$1/\rho = V_o \cdot \Sigma n_M f_M / W_M \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where ρ is the density in gm/cc, and V_o is given by

$$V_o = k + b_{Si} + \Sigma c_M N_M$$

n_M and m_M are the subscripts in the molecular formula of the component oxide M_mO_n, W_M is the molecular weight of M_mO_n, f_M is the fractional amount of the oxide present and N_M is found according to the formula

$$N_M = (n_M f_M / W_M) / \Sigma n_M f_M / W_M$$

The constants b_{Si} and the c_M's will determine the density of a glass whose composition is given by the f_M's.

Writing out equation (1), then, we have

$$1/\rho = \left\{ k + b_{Si} + \Sigma c_M \frac{m_M \ f_M/W_M}{\Sigma n_M \ f_M/W_M} \right\} \circ \ \Sigma n_M \ f_M/W_M$$

$$= (k + b_{Si}) \cdot \Sigma n_M f_M/W_M + \Sigma c_M / n_M f_M/W_M$$

$$= \Sigma \frac{(k + b_{Si})\, n_M + c_M m_M}{W_M} \cdot f_M \quad \ldots\ldots\ldots\ldots (2)$$

We can therefore compute the density according to the formula

$$1/\rho = \frac{f_1}{z_1} + \frac{f_2}{z_2} + \frac{f_3}{z_3} + \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where the density factors z_M have the value $W_M/[(k + b_{Si})n_M + c_M \ m_M]$ k is a constant whose value depends on the heat-treatment of the glass; if the glass is stabilized to give maximum density, $k = 0$. The values given for z_M in the table are computed for $k = 0$.

There are four sets of factors z_M, of which three have been computed. Each set applies to a limited range of composition, which is determined by the value of N_{Si}, computed according to the formula $N_{Si} = f_{Si}/\Sigma d_M f_M$ where d_M has the values shown in the table. Ordinarily N_{Si} will lie between 0.40 and 0.435, and, if similar glasses are being compared N_{Si} has to be computed for only one of these glasses. The factor for boron is accurate only for low amounts of boron; it can be used for glasses containing less than 80 per cent of silica and 8 per cent of B_2O_3.

HUGGINS' FACTORS FOR COMPUTING DENSITY

Component Oxide (M_mO_n)	d_M	z_M (N_{Si} = 0.345 to 0.40)	z_M (N_{Si} = 0.40 to 0.435)	z_M (N_{Si} = 0.435 to 0.50)
SiO_2	2	2.34	2.27	2.20
Na_2O	0.97	2.87	3.09	3.56
K_2O	0.64	2.68	2.79	3.04
CaO	1.07	3.87	4.31	5.44
MgO	1.49	2.78	3.10	3.91
BaO	0.39	7.6	8.2	9.6
Al_2O_3	1.77	2.4	2.7	3.4
B_2O_3	2.59	1.9	2.2	2.9
PbO	0.27	10	11	12
ZnO	0.74	5.4	5.9	7.4

For computing density, $1/\rho = f_1/z_1 + f_2/z_2 + f_3/z_3 + \ldots$, f being the fractional amount of oxide, and z its factor given above. In order to find the appropriate set of factors, calculate N_{S1} according to $N_{S1} = f_{S1}/(d_1f_1 + d_2f_2 + d_3f_3 + \ldots)$.

[1] M. L. Huggins, Ind. & Eng. Chem.: *32* 1433 (1940).

URBANA CONFERENCE

The Urbana Glass Conference, sponsored by the Department of Ceramics, University of Illinois, usually held in the spring of the year, has been deferred until the Fall due to departmental activities during the remaining weeks of the school year. Further details will be given later regarding the date of the Conference.

• Word comes from the Overmyer Mould Company of Winchester, Indiana, that "Chet, Jr." has volunteered for military service. He is Private C. P. Overmyer, Jr., Troop A, Third Training Squadron, Cavalry Replacement Center, Fort Riley, Kansas.

OSCAR HOMMEL DIES

Oscar Hommel, president and founder of the O. Hommel Co., Pittsburgh, died at his home in Pittsburgh on April 18. Mr. Hommel was 72 years old, and is survived by his wife, a son, and two daughters.

Mr. Hommel came to this country from Germany in his early twenties and later founded the ceramic color and chemical company which now bears his name. In December, 1938, a group of associates and employees gave him a testimonial dinner in recognition of his 70th birthday. Many individuals of prominence n the glass and ceramc industries attended and paid tribute to the great industrialist who has left a definite imprint on his time and whose passing will bring sorrow to hundreds.

COMPLAINT CHARGES MISREPRESENTATION

The serving of a formal complaint against S. Buchsbaum & Co., Chicago, Ill., was announced early in February in Washington by the Federal Trade Commission. The complaint charges the Chicago concern with misusing the word "glass" as part of the trade term "Elasti-Glass" employed to describe their products. They are distributors of synthetic belts, garters, suspenders and wrist-watch bands.

The complaint alleges that statements made in advertising by the Chicago company misrepresented these products to both retail merchants and the purchasing public, because the material from which the so-called "Elasti-Glass" articles are made is not glass but rather vinylite, a synthetic material. The complaint charges further that the use of the trade term was likely to confuse the products ("Elasti-Glass") with products made through processes for the fabrication of inorganic glass into materials suitable for use in the manufacture of various men's accessories, as well as women's accessories and household furnishings, which have been developed and are now in process of being developed at considerable expense by various members of the glass industry.

• "Export Control Regulations and Export Control Schedule No. 1" has been published by the Administrator of Export Control. This book will be of interest to United States exporters with reference to license procedure and affidavits.

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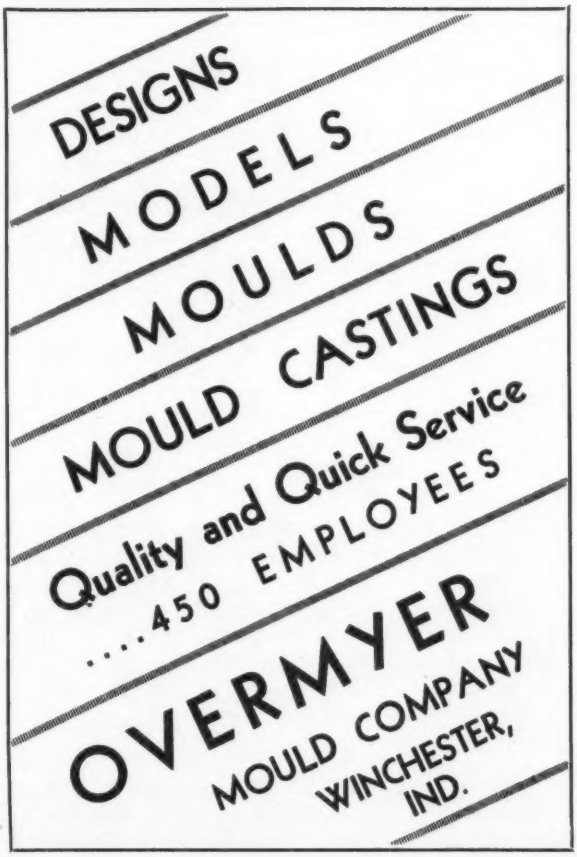

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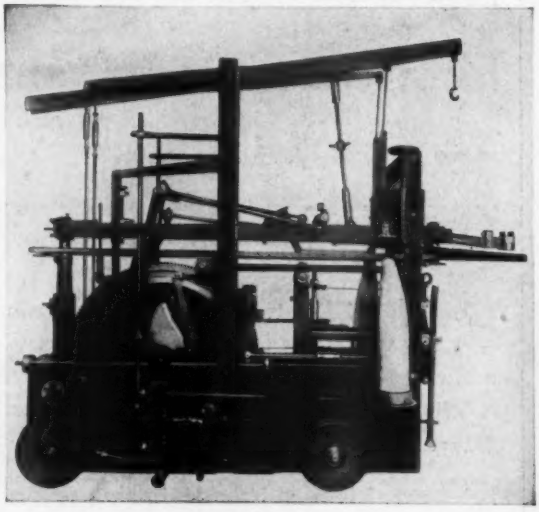

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